WESTERN DIGITAL SUPER BIOS USER'S GUIDE

Section 1.0: General

This document defines features and use of the Western Digital Super BIOS. The Super BIOS part number is 62-000094-031. The Super BIOS will operate on the following boards.

WD1002S-WX2	ST506/412 (MFM) to XT Bus. 8" Thru-hole card. 5 MHz.
WD1002S-WX2A	ST506/412 (MFM) to XT Bus. 8" Thru-hole card. 5 MHz.
WD1002A-WX1	ST506/412 (MFM) to XT Bus. Half-slot, surface-mount card. 5 MHz.
WD1002-27X	ST506/412 (RLL) to XT Bus. Half-slot, surface-mount card. 7.5 MHz.

Section 2.0: Features

* MFM Drive Tables

* RLL Drive Tables

* Auto-configuration
  The user can enter and reset drive configuration parameters at format time. The parameters are written to cylinder 0, head 0, sector 1. No information is written to cylinder 0, head 0, sector 1 when static drive tables are used to format the drive.

* Virtual Drive Formatting and Operation
  The user should never run the IBM Advanced Diagnostices Format Drive option on the first virtual drive. Doing so will destroy the data on the second virtual drive when the format drive command is issued. For this mode of operation only one hard drive should be attached to the controller.

Ken Wing WX6P
BESTRONICS OF SAN DIEGO INC.
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(619) 693-1111

* Dual Controller Operation

  The first controller must be set for BIOS address C800H and I/O address 320H. The second controller must be set for BIOS address CA00H and I/O address 324H.
  Only one hard drive should be attached to each controller if using DOS. Furthermore the virtual drive option should not be used.

* Bad Track Formatting

* Compatable with both XT and AT systems

  The AT must have system BIOS #6181028 and #6181029 (1981-1984) for use with DOS 2.1 and system BIOS #6480090 and #6480091 (1985) for use with DOS 3.0, 3.1, and 3.2. Drives operating on the XT controller are not setup in the configuration memory of the AT.
  The XT controller must be set for the first controller if it is the only Winchester controller in the AT. Also, the setup must be run to tell the AT there are 0 drives.
  If the XT controller is to operate with an AT Winchester controller, then it must be set for second controller. The drive attached to the AT controller must be setup in configuration memory.
  If there is no hard drive attached to the AT Winchester controller, then the XT controller is setup for first controller.
  If two XT controllers are to operate in the AT than one is set for first and the other for second. Also, setup must be run to tell the AT there are 0 drives.

Section 3.0: MFM Drive Tables

Table 3	Table 2	Table 1	Table 0
615 Cylinders	615 Cylinders	306 Cylinders	612 Cylinders
4 Heads	2 Heads	4 Heads	4 Heads
450 RWC	450 RWC	153 RWC	450 RWC
450 WPC	450 WPC	0 WPC	450 WPC
11 EBL	11 EBL	11 EBL	11 EBL
5 CCB	5 CCB	5 CCB	5 CCB

RWC = Reduced write current.
WPC = Write precompensation.
EBL = Maximum correctable Error Burst Length.
CCB = Command Control Block option byte.

Section 3.1: BIOS address of MFM Drive Tables

Segment address = C800: (First controller) or,
CA00: (Second controller).

Offset address				
Table 3	Table 2	Table 1	Table 0	Definition
:0073 67h	:0063 67h	:0053 32h	:0043 64h	Split cyl. (LSB)
:0074 02h	:0064 02h	:0054 01h	:0044 02h	Split cyl. (MSB)
:0075 04h	:0065 02h	:0055 04h	:0045 04h	Physical heads
:0076 C2h	:0066 C2h	:0056 99h	:0046 C2h	RWC cyl. (LSB)
:0077 01h	:0067 01h	:0057 00h	:0047 01h	RWC cyl. (MSB)
:0078 C2h	:0068 C2h	:0058 00h	:0048 C2h	WPC cyl. (LSB)
:0079 01h	:0069 01h	:0059 00h	:0049 01h	WPC cyl. (MSB)
:007A 0Bh	:006A 0Bh	:005A 0Bh	:004A 0Bh	Error Burst Length
:007B 05h	:006B 05h	:005B 05h	:004B 05h	CCB Option Byte
:007C 67h	:006C 67h	:005C 32h	:004C 64h	Physical cyl. (LSB)
:007D 02h	:006D 02h	:005D 01h	:004D 02h	Physical cyl. (MSB)
:007E 00h	:006E 00h	:005E 00h	:004E 00h	Reserved
:007F 00h	:006F 00h	:005F 00h	:004F 00h	Reserved
:0080 00h	:0070 00h	:0060 00h	:0050 00h	Reserved
:0081 00h	:0071 00h	:0061 00h	:0051 00h	Reserved
:0082 00h	:0072 00h	:0062 00h	:0052 00h	Reserved

Section 4.0: RLL Drive Tables

Table 3	Table 2	Table 1	Table 0
615 Cylinders	612 Cylinders	987 Cylinders	981 Cylinders
4 Heads	4 Heads	7 Heads	5 Heads
616 RWC	613 RWC	988 RWC	982 RWC
616 WPC	613 WPC	988 WPC	982 WPC
11 EBL	11 EBL	11 EBL	11 EBL
7 CCB	7 CCB	0 CCB	7 CCB

RWC = Reduced write current.
WPC = Write precompensation.
EBL = Maximum correctable error burst rate.
CCB = Command control block option byte.

Section 4.1: BIOS address of RLL Drive Tables

Segment address = C800: (First controller) or,
CA00: (Second controller).

Offset address				
Table 3	Table 2	Table 1	Table 0	Definition
:00B5 67h	:00A5 64h	:0095 DBh	:0085 D5h	Split cyl. (LSB)
:00B6 02h	:00A6 02h	:0096 03h	:0086 03h	Split cyl. (MSB)
:00B7 04h	:00A7 04h	:0097 07h	:0087 05h	Physical heads
:00B8 68h	:00A8 65h	:0098 DCh	:0088 D6h	RWC cyl. (LSB)
:00B9 02h	:00A9 02h	:0099 03h	:0089 03h	RWC cyl. (MSB)
:00BA 68h	:00AA 65h	:009A DCh	:008A D6h	WPC cyl. (LSB)
:00BB 02h	:00AB 02h	:009B 03h	:008B 03h	WPC cyl. (MSB)
:00BC 0Bh	:00AC 0Bh	:009C 0Bh	:008C 0Bh	Error Burst Length
:00BD 07h	:00AD 07h	:009D 00h	:008D 07h	CCB Option Byte
:00BE 67h	:00AE 64h	:009E DBh	:008E D5h	Physical cyl. (LSB)
:00BF 02h	:00AF 02h	:009F 03h	:008F 03h	Physical cyl. (MSB)
:00C0 00h	:00B0 00h	:00A0 00h	:0090 00h	Reserved
:00C1 00h	:00B1 00h	:00A1 00h	:0091 00h	Reserved
:00C2 00h	:00B2 00h	:00A2 00h	:0092 00h	Reserved
:00C3 00h	:00B3 00h	:00A3 00h	:0093 00h	Reserved
:00C4 00h	:00B4 00h	:00A4 00h	:0094 00h	Reserved

Section 5.0: Step Rate Tables

The CCB option byte in conjunction with the onboard microprocessor selects the desired step rate.

CCB Option Byte	Microprocessor Version	Step Rate
	1015-14	
0		3 msec. per step
1		3 msec. per step
2		3 msec. per step
3		3 msec. per step
4		200 usec. per step
5		70 usec. per step
6		3 msec. per step
7		3 msec. per step
	1015-24, 1015A-24	
0		3 msec. per step
1		45 usec. per step
2		60 usec. per step
3		18 usec. per step
4		210 usec. per step
5		75 usec. per step
6		30 usec. per step
7		18 usec. per step
	1015A-25	
0		3.1 msec. per step
1		46.5 usec. per step
2		22.5 usec. per step
3		10.5 usec. per step
4		202.5 usec. per step
5		70.5 usec. per step
6		38.5 usec. per step
7		10.5 usec. per step
	1015E-08	
0		3.3 msec. per step
1		24 usec. per step
2		24 usec. per step
3		11 usec. per step
4		24 usec. per step
5		24 usec. per step
6		24 usec. per step
7		11 usec. per step

Section 6.0: Configuration Switch (SW)

SW refers to either location SW1 or location S1 on the controller card.

Jumper Installed = ON, Jumper Not Installed = OFF

SW-1 LSB Drive 0 table select.
SW-2 MSB Drive 0 table select.
SW-3 LSB Drive 1 table select.
SW-4 MSB Drive 1 table select.
SW-5 LSB Options select.
SW-6 MSB Options select.
SW-7 IRQ select. OFF=IRQ5, ON=IRQ2 (e.g. Tandy 1000)
SW-8 AT select. OFF=XT, ON=AT

Section 6.1: Drive 0 Decode (SW-1 and SW-2)

SW-2	SW-1	Definition
ON	ON	Drive 0 will use table 0.
ON	OFF	Drive 0 will use table 1.
OFF	ON	Drive 0 will use table 2.
OFF	OFF	Drive 0 will use table 3.

Section 6.2: Drive 1 Decode (SW-3 and SW-4)

SW-4	SW-3	Definition
ON	ON	Drive 1 will use table 0.
ON	OFF	Drive 1 will use table 1.
OFF	ON	Drive 1 will use table 2.
OFF	OFF	Drive 1 will use table 3.

Section 6.3.0: Options Decode (SW-5 and SW-6) for MFM

SW-6	SW-5	Tables	SPT
OFF	OFF	MFM	17
OFF	ON	UNDEFINED	
ON	OFF	UNDEFINED	
ON	ON	UNDEFINED	

Section 6.3.1: Options Decode (SW-5 and SW-6) for RLL

SW-6	SW-5	27X W-9 Must be	Tables	SPT	BIOS XLATE	DYNAMIC CONFIG.	EQUIVALENT RLL STANDARD BIOS
OFF	OFF				UNDEFINED		
OFF	ON	OFF	RLL	17	YES	NO	1
ON	OFF	OFF	RLL	26	NO	YES	2
ON	ON	ON	RLL	17	NO	YES	0

Section 7.0: Format Example

1. Boot the machine from drive A:

2. Load DOS debug utility by typing:

   A>debug <Return>

3. At the debug prompt (-) type:

   -g=c800:5 <Return>

4. The screen should display the following:

   WX2 Format Revision 1.0S (C) Copyright Western Digital Corp. 1986

   Current Drive is C:, Select new Drive or RETURN for current.

5. Press Return for drive C: or type D: <Return> for drive D:

6. The screen should display the following:

   Current Interleave is 3, Select new interleave or RETURN for current.

7. Press Return or type new interleave value <Return>.

8. The screen should display the following:

   Are you dynamically configuring the drive - answer Y/N

9. If no, type n <Return> and go to step 16 . You are using drive tables.
   If yes, type y <Return> and continue. You are not using drive tables and will enter the parameters via the keyboard.

10. The screen should display the following:

    Key in disk characteristics as follows:ccc h rrr ppp ee o
    where
    ccc = total number of cylinders (1-4 digits)
    h = number of heads (1-2 digits)
    rrr = starting reduced write current cylinder (1-4 digits)
    ppp = write precomp cylinder (1-4 digits)
    ee = max correctable error burst length (1-2 digits)
         range = 5 to 11 bits, default = 11 bits
     o = CCB option byte, step rate select (1 hex digit)
         range = 0 to 7, default = 5
         refer to controller and drive specification for step
         rates

11. For example, type the following:

    615 4 616 616 11 5 <Return>

12. The screen should display the following:

    Are you virtually configuring the drive - answer Y/N

13. If no, type n <Return> and go to step 16.
    If yes, type y <Return> and continue. There can only be one physical drive.

14. The screen should display the following:

    Key in cylinder number for virtual drive split as vvvv ...
    where vvvv = number of cylinders for drive C: (1-4 digits)

15. For example, type the following:

    300 <Return>

    Note: Drive D: will use the remaining cylinders. For example, 615-300=315.

16. The screen should display the following:

    Press "y" to begin formatting drive (C or D) with interleave (03 or value entered above)

17. Press y <Return> to begin the Low Level Format. Any other key will exit with nothing done.

18. The screen should display the following:

    Formatting . . .

    Do you want to format bad tracks - answer Y/N

19. If no, type n <Return> and go to step 25.
    If yes, type y <Return> and continue.

20. The screen should display the following:

    Key in bad track list as follows: ccc h ...
    where
    ccc = bad track cylinder no (1-4 digits)
    h = bad track head number (1-2 digits)

21. For example, type the following:

    100 0 100 3 245 1 300 2 <Return>

22. The screen should display the following:

    More ? Y/N -

23. If you have more bad tracks to enter type y <Return> and go to step 20.
    If not, type n <return> and continue.

24. The screen should display the following:

    BAD TRACK MAP

TRACK ADDR	PROBLEM
ccc h	USER-SUPPLIED

25. The screen should display the following:

    Format Successful

    System will now restart

    Insert DOS diskette in drive A:
    Press any key when ready.

26. If the drive was virtually configured, this Low Level Format IS NOT run on drive D:, however, if a second physical drive is to be formatted, repeat this procedure.

27. Load and execute DOS FDISK utility for both drive C: and D: regardless of virtual or physical.

    FDISK read parameters should indicate the proper split of cylinders for drive C: and D:.

28. Load and execute DOS Format utility for both drive C: and D: regardless of virtual or physical.

M255XA
5¼" Mini-Flexible Disk Drives
Product Specification

FUJITSU

TS-007-062785...03

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SECTION 1
INTRODUCTION

1.1 SCOPE

This manual explains the functions and specifications for the FUJITSU M255XA Family of 5¼" Mini (Half-Height) Flexible Disk Drives.

This Section gives an overview of the M255XA Family.

Section 2 contains performance specifications.

Section 3 contains mounting and installation information.

Section 4 contains interface and Drive Select information.

Section 5 contains schematic drawings.

1.2 GENERAL DESCRIPTION

These disk drives offer superior performance, reliability and construction in Half-Height 5¼" Flexible Disk Drive technology. Industry standard soft sectored 5¼" (130mm) diskettes are used as the storage medium. These drives have an independently addressed Read/Write head for each side of the diskette.

There are four model numbers in the M255XA Family:

M2551A Storage capacity and 9-sector format allows the M2551A to emulate a 5¼" industry standard, double sided, **48 Track per inch** Disk Drive.

M2552A Storage capacity and 16-sector format allows the M2552A to emulate a 5¼" industry standard, double sided, **96 Track per inch** Disk Drive.

M2553A Storage capacity and 15-sector format allows the M2553A to emulate a 1.6 Megabyte industry standard, double sided, **96 Track per inch** Disk Drive.

M2554A A host system controlled interface line allows this unit to operate with a spindle speed of 300 RPM or 360 RPM.

At 300 RPM and with a 16-sector format, the M2554A emulates a 5¼" industry standard, double sided, **96 Track per inch** Disk Drive (similar to the M2552A).

At 360 RPM with a 15-sector format, the M2554A emulates a 1.6 Megabyte industry standard, double sided, **96 Track per inch** Disk Drive (similar to the M2553A).

MFM or FM recording methods are acceptable. Flux transitions per inch are:

M2551A 5876 bits per inch

M2552A 5922 bits per inch

M2553A 9646 bits per inch 360 RPM

M2554A 5922 bits per inch at 300 RPM
9646 bits per inch at 360 RPM

With MFM recording methods, per disk Unformatted Storage Capacity and Data Transfer Rate is:

M2551A 500KB Unformatted Storage - 250KHz Data Transfer Rate

M2552A 1000KB Unformatted Storage - 250KHz Data Transfer Rate

M2553A 1604KB Unformatted Storage - 500KHz Data Transfer Rate

M2554A 1000KB Unformatted Storage - 250KHz Data Transfer Rate at 300 RPM
1604KB Unformatted Storage - 500KHz Data Transfer Rate at 360 RPM

With FM recording methods, per disk Unformatted Storage Capacity and the Data Transfer Rate are half of the above.

Track density is 96 TPI, except for the M2551A which operates at 48 TPI.
Number of Cylinders and Tracks is:

M2551A 40 Cylinders/80 Tracks

M2552A 80 Cylinders/160 Tracks

M2553A 80 Cylinders/160 Tracks

M2554A 80 Cylinders/160 Tracks at 300 RPM or 360 RPM

Track to Track access time is 3 milliseconds (6 milliseconds for the M2551A), plus a 15 millisecond settling time. Average Access time, including settling time, is:

M2551A 93 milliseconds (2 steps per track)

M2552A 94 milliseconds (1 step per track)

M2553A 94 milliseconds (1 step per track) for 80 cylinder operation
91 milliseconds (1 step per track) for 77 cylinder operation

M2554A 94 milliseconds (1 step per track) for 80 cylinder operation
91 milliseconds (1 step per track) for 77 cylinder operation

M2551A and M2552A spindle motor speed is 300 RPM.

M2553A spindle motor speed is 360 RPM.

M2554A spindle motor speed is host system selected (via an interface signal line) at 300 or 360 RPM.

Except for the differences listed above, performance of the units is identical.

Complete specifications are given in Section 2.

1.3 KEY FEATURES

- Half-Height (1.625 inches)
- Industry standard flexible disk drive mounting
- 5¼" and 8" flexible disk drive emulation
- Up to 1.604 Megabyte Unformatted storage capacity
- Door lever cannot be turned until media is inserted to prevent the heads from engaging
- High quality and reliability
- FUJITSU AMERICA support

1.4 OPTIONS AND ACCESSORIES

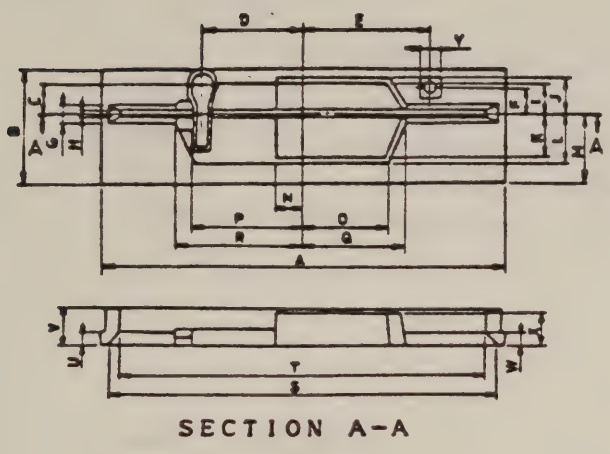
- Automatic Diskette Eject
  Ejects the diskettes from the disk drive, when the door lever is released. The disk drive is set to the Not Ready State (when the diskette is ejected).

- Head Load Solenoid
  Allows the host system to Load/Unload the Read/Write heads in the disk drive via an interface signal line. This option is not applicable on the M2551A or M2552A.

- Auto-Rezero
  Rotates the diskette (to full speed) and retracts the Read/Write heads to Track 00, whenever power is turned-on. This option is not applicable on the M2551A or M2552A.

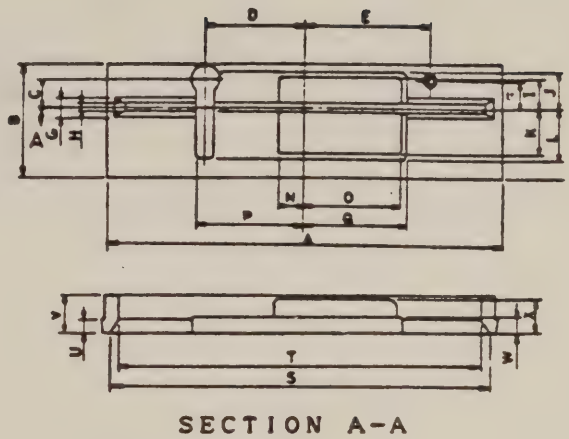
- Bezel Modification
  Two standard bezel styles are offered. Figure 1-1, on the following page, provides a drawing and the measurements of each bezel.

Bezel 1



SECTION A-A

Bezel 2



SECTION A-A

	Bezel 1		Bezel 2	
	Inches	mm	Inches	mm
A	5.87	149.0	5.83	148.0
B	1.69	42.8	1.65"	42.0
C	0.41	10.5	0.41	10.5
D	1.48	37.6	1.48	37.6
E	1.85	47.0	1.85	47.0
F	0.40	10.0	0.40	10.0
G	0.28	7.0	0.30	7.5
H	0.13	3.4	0.13	3.4
I	0.45	11.5	0.45	11.5
J	0.53	13.5	0.53	13.5
K	0.65	16.5	0.67	17.0
L	0.73	18.5	0.75	19.0
M	1.03	26.2	1.02	26.0
N	0.40	10.0	0.40	10.0
O	1.26	32.0	1.42	36.0
P	1.62	41.1	1.62	41.1
Q	1.50	38.0	1.50	38.0
R	1.86	47.1	--	--
S	5.67	144.0	5.59	142.0
T	5.35	135.8	5.35	135.8
U	0.20	5.0	0.20	5.0
V	0.55	14.0	0.55	14.0
W	0.20	5.0	0.24	6.0
X	0.49	12.4	0.49	12.4
Y	0.32	8.0	--	--

Figure 1-1 Bezel Styles

SECTION 2

SPECIFICATIONS

2.1 PHYSICAL DIMENSIONS

Refer to Figure 2-1.

Height: 1.625 ±0.02 inches (41.00 ±0.5mm)
Width: 5.75 ±0.02 inches (146.00 ±0.5mm)
Depth*: 8.00 ±0.02 inches (203.00 ±0.5mm)
Weight: 3.50 pounds (1.4Kg) maximum
* Without interface connector

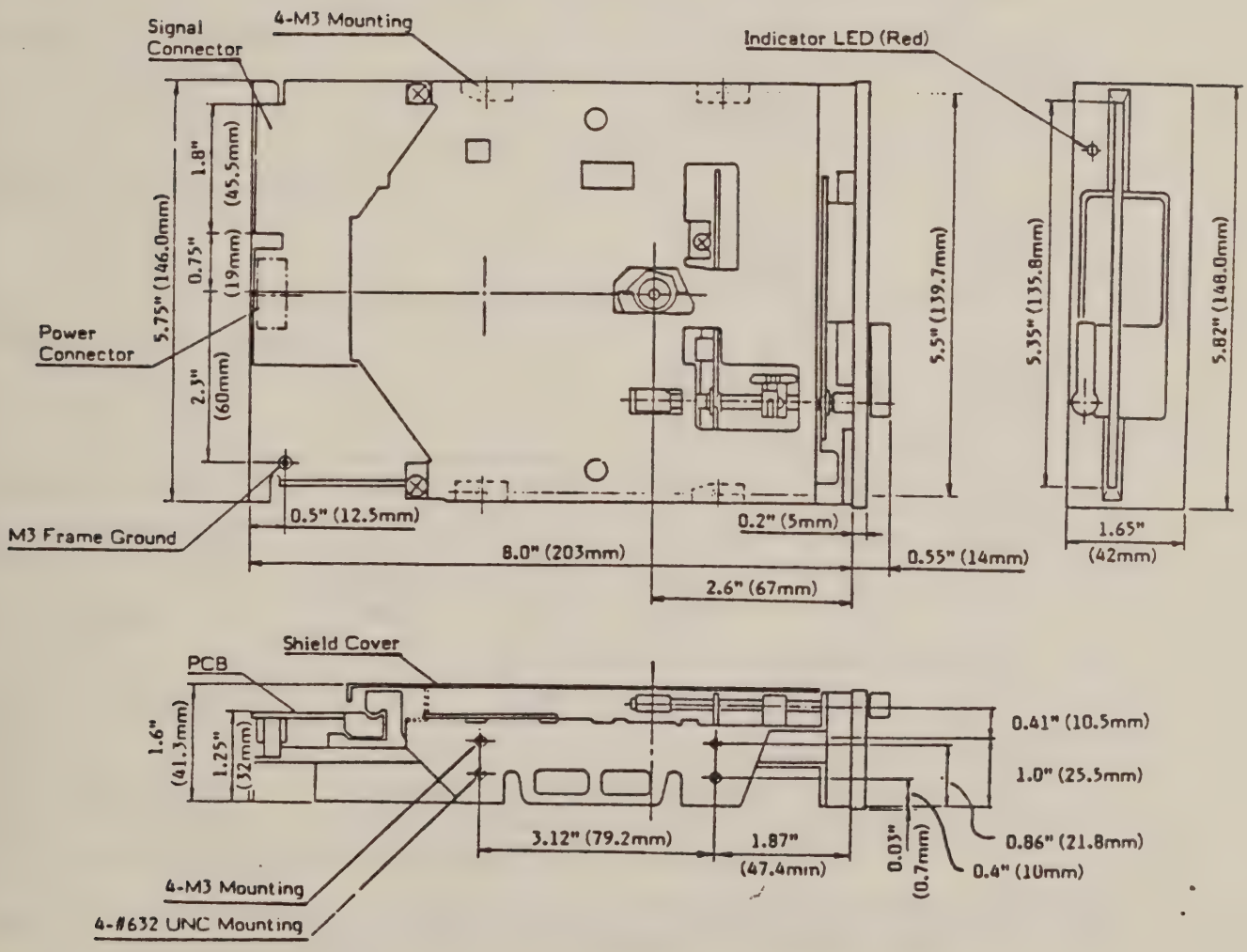


Figure 2-1 External Outline Drawing of a M255XA Disk Drive

2.2 STORAGE CAPACITY

Refer to Table 2-1.

Table 2-1 Storage Capacity with MFM Recording*

MODEL NUMBER	M2551A	M2552A	M2553A	300 RPM M2554A	360 RPM M2554A
UNFORMATTED:					
Each Diskette	500KB	1000KB	1604KB	1000KB	1604KB
Each Track	6.25KB	6.25KB	10.416KB	6.25KB	10.416KB
FORMATTED 16-Sectors					
Each Diskette	327.68KB	655.36KB	-	655.36KB	-
Each Track	4.096KB	4.096KB	-	4.096KB	-
Each Sector	256 Bytes	256 Bytes	-	256 Bytes	-
FORMATTED 8-Sectors					
Each Diskette	-	-	1311KB	-	1311KB
Each Track	-	-	8.192KB	-	8.192KB
Each Sector	-	-	1.024KB	-	1.024KB
FORMATTED 15-Sectors					
Each Diskette	-	-	1229KB	-	1229KB
Each Track	-	-	7.680KB	-	7.680KB
Each Sector	-	-	512 Bytes	-	512 Bytes
FORMATTED 26-Sectors					
Each Diskette	-	-	1065KB	-	1065KB
Each Track	-	-	6.656KB	-	6.656KB
Each Sector	-	-	256 Bytes	-	256 Bytes
BITS PER INCH	5876	5922	9646	5922	9646
TRACKS PER INCH	48 TPI	96TPI	96TPI	96TPI	96TPI
# OF TRACKS See Note 1	80	160	160	160	160
# OF CYLINDERS See Note 1	40	80	80	80	80
TRANSFER RATE	250KHz	250KHz	500KHz	250KHz	500KHz

* = 1/2 the Formatted and Unformatted Storage values shown with FM Recording.

Note 1: The M2553A and the M2554A at 360 RPM may be configured for either 160 or 154 Tracks and 80 or 77 Cylinders. Formatted capacities reflect 80 cylinder operation.

2.3 DISK MECHANISM

Refer to Table 2-2.

Table 2-2 Disk Mechanism

MODEL NUMBER	M2551A	M2552A	M2553A	300 RPM M2554A	360 RPM M2554A
SPINDLE SPEED	300 RPM	300 RPM	360 RPM	300 RPM	360 RPM
AVERAGE LATENCY TIME (Disk Rotation)	100 msec	100 msec	83.3 msec	100 msec	83.3 msec
SPEED VARIATION	±1.5% Maximum Long Term & Instantaneous				
ROTATIONAL CONTROL	AC Tachometer Controlled Frequency Servo				
SPINDLE MOTOR TYPE	Direct Drive DC Brushless Motor				
SPINDLE MOTOR START TIME	400 milliseconds maximum				

2.4 TRACK ACCESS MECHANISM

Refer to Table 2-3.

Table 2-3 Track Access Mechanism

MODEL NUMBER	M2551A	M2552A	M2553A	300 RPM M2554A	360 RPM M2554A
STEPS PER TRACK	2 steps	1 step	1 step	1 step	1 step
ACCESS TIME Track to Track (Without settling time) Average (Inner-track) (With settling time)	 6 msec 93 msec	 3 msec 94 msec	 3 msec 94 msec*	 3 msec 94 msec	 3 msec 94 msec*
POSITIONING ACCURACY	Within ±20 micrometers at 96 TPI and within ±35 micrometers at 48 TPI (M2551A), using a standard test diskette (Track 32 at 23±2° C, 40-60% RH, and Track 16 for the M2551A)				
HEAD SETTLING TIME	15 milliseconds maximum, does not include track access time				
HEAD CARRIAGE DRIVE	4-Phase Stepper Motor and Steel Belt				
TRACK 00	LED and Phototransistor Detection Mechanical stop on head carriage				

* = 91 msec Average Access Time when using 154 tracks (rather then 160 tracks).

2.5 READ/WRITE HEAD AND TRACK SPECIFICATIONS

Refer to Table 2-4. See Section 4 for additional information.

Table 2-4 Read/Write Head and Track Specifications

TYPE OF R/W HEAD	Gimbal supported with Tunnel Erase
NUMBER OF R/W HEADS	Two (one on each side of the Diskette)
R/W HEAD TRACK WIDTH	0.160mm standard - 96 TPI 0.150 ±0.015mm after Tunnel Erase: 0.330mm standard - 48 TPI (M2551A) 0.300 ±0.015mm after Tunnel Erase
ERASE HEAD WIDTH (Both sides of Diskette)	0.100mm standard - 96TPI 0.160mm standard - 48TPI (M2551A)
WRITE/READ - ERASE GAP	0.85 ±0.05mm - M2551A and M2552A 0.58 ±0.05mm - M2553A and M2554A
WRITE/READ GAP AZIMUTH	0 ±18' on standard test diskette
TRACK RADIUS (Maximum)	
Track 00 (External Lap):	57.150mm Side 0 55.033mm Side 1
Track 76	37.042mm Side 0 34.925mm Side 1
Track 79 (Internal Lap):	36.248mm Side 0 34.131mm Side 1

2.6 INDEX PULSE

Refer to Figure Table 2-5. See Section 4 for additional information.

Table 2-5 INDEX Pulse

INDEX DURATION	1 to 8 milliseconds (use the leading edge)
TIME BETWEEN INDEX PULSES	200.00 milliseconds ±1.5% at 300 RPM 166.67 milliseconds ±1.5% at 360 RPM
INDEX ACCURACY	200 ±100 microseconds from the beginning of the INDEX hole on a standard test diskette
FIRST INDEX PULSE	400 millisecond nominal after Motor Start
NUMBER OF PULSES	One (1) INDEX Pulse per disk revolution
INDEX DETECTION	LED and Phototransistor

2.7 POWER REQUIREMENTS

Refer to Table 2-6. See Section 4 for additional information.

Table 2-6 Power Supply Requirements

+12 VOLTS DC	±5% allowable variance during read/write operations and ±10% at other times 200 millivolt maximum peak-to-peak ripple voltage (including noise spikes) 0.22 Amperes average current draw 0.60 Amperes maximum average current draw 0.90 Amperes peak current draw (Spindle Motor start-up) 0.07 Amperes maximum current draw (Spindle Motor idle)
+5 VOLTS DC:	±5% allowable variance 100 millivolt maximum peak-to-peak ripple voltage (including noise spikes) 0.29 Amperes average current draw 0.33 Amperes maximum current draw (Spindle Motor idle) 0.50 Amperes maximum average current draw (standby mode) 0.60 Amperes maximum average current draw (operating)
Power Consumption:	4.1 Watts nominal when operating 2.0 Watts nominal when the Spindle Motor is stopped

2.8 ENVIRONMENTAL CONDITIONS

Refer to Table 2-7.

Table 2-7 Environmental Conditions

	OPERATING	STORAGE	TRANSPORT*
Ambient Temperature	4 to 46° C	-22 to 60° C	-40 to 65° C
Temperature Gradients (Maximum)	15° C/hour Non-condensed	Not Specified	30° C/hour Non-condensed
Relative Humidity Maximum Wet-Bulb	20 to 80% Max. 29° C Non-condensed	10 to 90% Max. 40° C Non-condensed	5 to 95% Max. 45° C Non-condensed
Vibration Tolerance (Maximum)	0.50G 55Hz 0.25G 55 to 150HZ	Not Specified	2.0G 100Hz
Shock Tolerance (Maximum)	10G 10msec	Not Specified	40G 10msec

* Packed in designated crates with conditions conforming to JIS-Z0200 - Provisions for Correctly Packed Freight Testing Methods; Level II.

When transport takes place over an extended period (such as trans-oceanic by ship) the Storage Environmental Conditions apply.

2.9 RELIABILITY

Refer to Table 2-8.

Table 2-8 Reliability	
MEAN TIME BETWEEN FAILURES (MTBF)	11,000 Power-on hours, with 25% duty cycle
MEAN TIME TO REPAIR (MTTR)	30 Minutes Maximum to subassembly level
PERIODIC MAINTENANCE	Not required. Head Cleaning if necessary
PRODUCT LIFE	5 years
DISK LIFE	Three times 10^6 passes/track minimum
DISKETTE INSERTIONS	One times 10^4 insertions minimum
DATA ERROR RATES:	
Soft Read Error Rate	One per 10^9 bits (with up to 2 re-reads)
Hard Read Error Rate	One per 10^{12} bits (with more than 2 re-reads)
SEEK ERROR RATE	One per 10^6 seeks

2.10 REGULATORY AGENCY CERTIFICATION

Refer to Table 2-9.

Table 2-9 Regulatory Agency Certification	
FCC (Federal Communications Commission) See FCC Statement on inside of back cover.	CFD 75U255X
UL (Underwriters Laboratories)	UL E8729-1
CSA (Canadian Standards Association)	LR 60527-1

2.11 WRITE PROTECT MECHANISM

Diskette's Write Protect Notch is detected with an LED and Phototransistor.

2.12 I/O SIGNAL INTERFACE

I/O control and data signal specifications are given in Section 4, Electrical Interface.

SECTION 3

MOUNTING REQUIREMENTS

3.1 MOUNTING ORIENTATION

A double metal chassis structure design separates the mounting chassis (and main circuit board) from the Spindle and Read/Write head assemblies. This design offers high shock resistance and omits distortion (due to mounting stress) between the Spindle and the Read/Write heads.

Refer to Figure 3-1. The mounting orientation may be:

Vertical - with the front lever at the top

Horizontal - with the spindle motor facing downward

The unit must be level - within $\pm 15^{o}$ - from front to rear

3.2 MOUNTING HOLES

Refer to Figure 3-1. The location of each mounting hole is identical to $5\frac{1}{4}$" disk drive industry standards (ST506/412).

Twelve mounting holes - four on the bottom and four on each side - are provided to mount the disk drive.

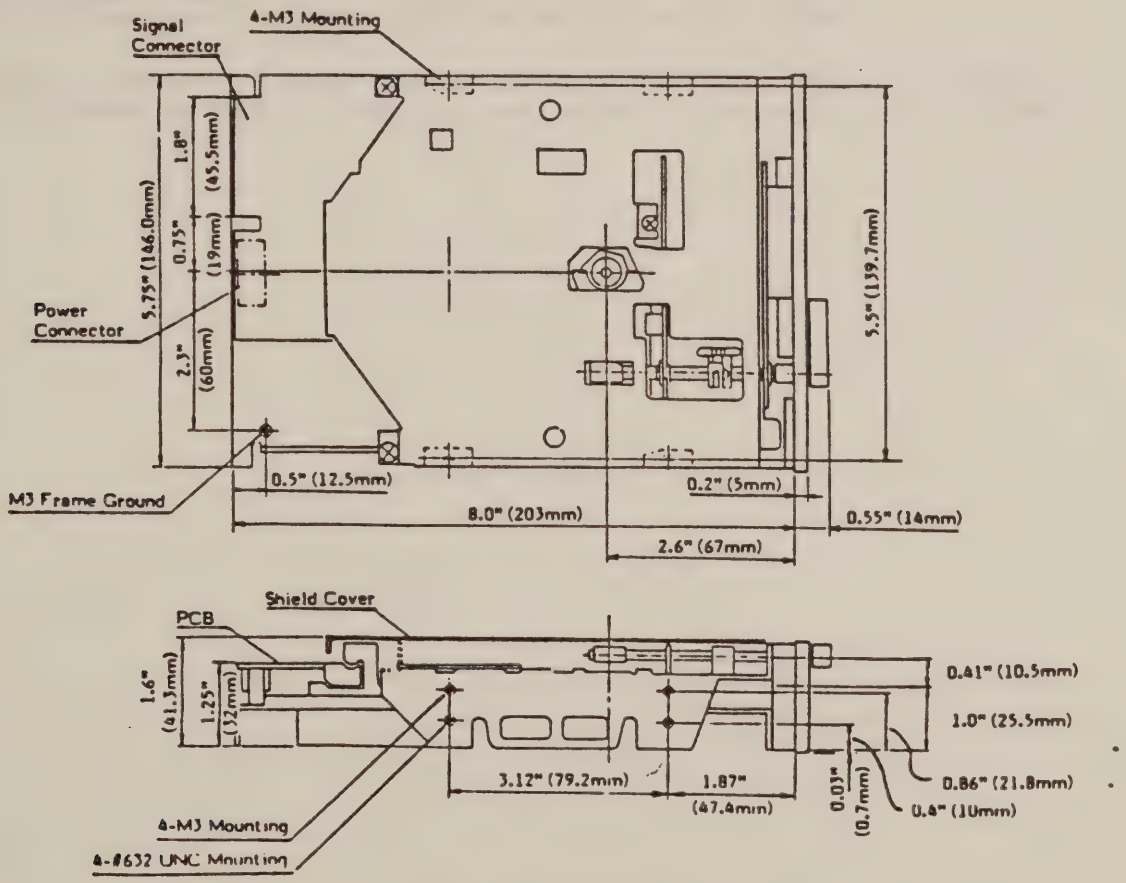


Figure 3-1 Mounting Holes

3.3 COOLING

When the disk drive is mounted in an environment that provides a free flow of air over the components, convection cooling allows operation of the drive within the specified temperature range.

When the drive is mounted in a confined environment, air flow may have to be provided to maintain the specified temperature range in the vicinity of the main circuit board, motors, and diskette.

3.4 POWER

Power to the drive is via connector J2/P2, located on the non-component side of the main circuit board near the interface connector. The drive uses +12VDC and +5VDC. Table 2.6 provides power supply requirements and paragraph 4.8 provides power supply interface information.

3.5 INPUT/OUTPUT CABLE

Section 4 provides complete interface information.

3.6 OTHER REQUIREMENTS

DRIVE SELECT jumpers and additional information is given in Section 4.

Contact your authorized Fujitsu representative to discuss optimum mounting conditions, alternate installation positions, and other details not mentioned in this manual.

SECTION 4

ELECTRICAL INTERFACE AND DRIVE SELECT

4.1 GENERAL

Signal characteristics are given in Paragraph 4.2.

Interface Connector and Cable characteristics are given in Paragraph 4.3.

DRIVE SELECT information, including jumper placement, is given in paragraphs 4.2 and 4.4.3. A maximum of four drives may be directly selected by the DRIVE SELECT Jumpers (DS0, DS1, DS2 or DS3).

Electrical interface signals are grouped into the following categories:

- Input Control Signals - see Paragraph 4.4
- Output Control Signals - see Paragraph 4.5
- Data Transfer (Read/Write) Signals - see Paragraph 4.6
- Summary of M2553A/M2554A Jumper Options - see Paragraph 4-7
- Modification of Drive for use with an IBM PC/AT - see Paragraph 4-8
- Timing Relationships - see Paragraph 4.9
- Power Interface - See Paragraph 4.10

Input Control, WRITE GATE, and WRITE DATA Signals are digital in nature. These input signals are received with a TTL7414 or equivalent circuit, shown in Figure 4-1.

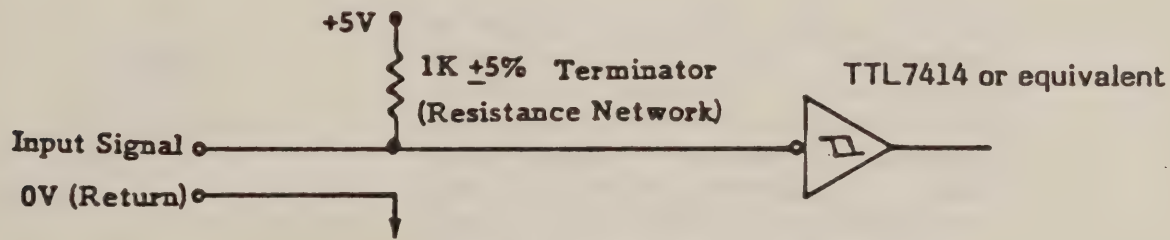


Figure 4-1 Input Signal Receiver Pair

Output Control, and READ DATA Signals are digital in nature. These output signals are driven with a TTL7438 or equivalent circuit, shown in Figure 4-2.

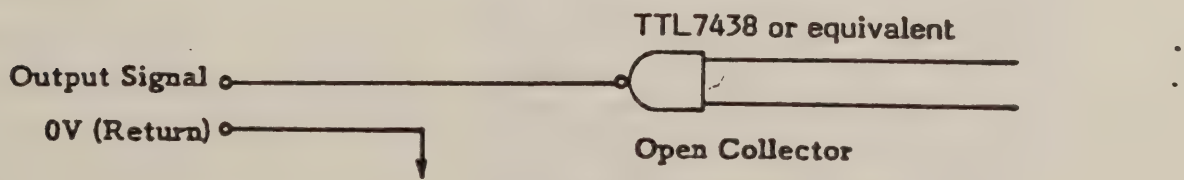


Figure 4-2 Output Signal Driver Pair

4.2 SIGNAL CHARACTERISTICS

Signal characteristics, at the disk drive's J-1 Interface Connector, are:

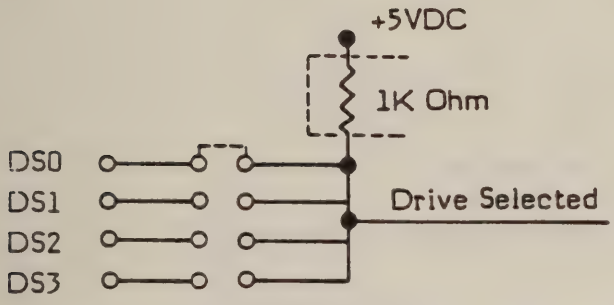
Input Signal

Low level (True):	0 to 0.5 Volts DC
High level (False):	2.5 to 5.25 Volts DC
Input impedance:	1 K Ohm ±5% Pull-up at 5 Volts DC

Output Signal

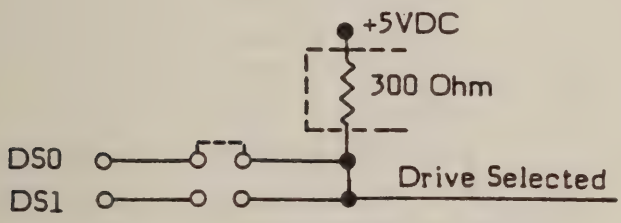
Low level (True):	0 to 0.4 Volts DC
High level (False):	5.25 Volts Maximum
Absorption current:	48 milliampere maximum

Input Signal Terminator: Terminating resistance for DRIVE SELECT and other input signal lines are shown below.



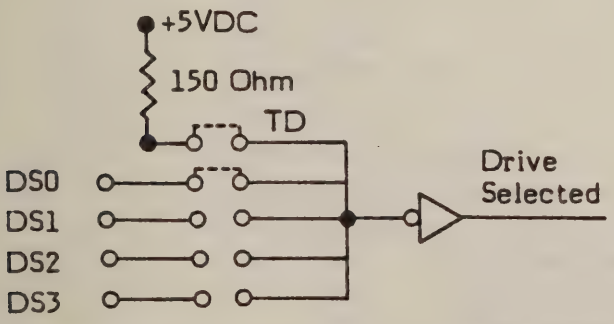
Refer to Figure 4-3A. Older M2551A and M2552A drives use 1K Ohm terminating resistors. In Daisy Chain, when a 1K Ohm terminating resistor is used, line resistance is 500 Ohms with two drives, 333 Ohms with three drives and 250 Ohms with four drives. This Terminating Resistor package is not removable.

Figure 4-3A Older M2551A and M2552A Termination



Refer to Figure 4-3B. Newer M2551A drives use 300 Ohm terminating resistors. Ensure that there are no more than 2 drives connected in a Daisy Chain. Terminating resistance with two drives connected in Daisy Chain is 150 Ohms. This Terminating Resistor package is not removable.

Figure 4-3B Newer M2551A Termination



Refer to Figure 4-3C. On a M2553A or M2554A drive, a TD jumper is used to connect or remove the DRIVE SELECT signal line terminating resistance. M2553A and M2554A drives use 150 Ohm signal line terminating resistors on all input signal lines. This Terminating Resistor package (RA1) is removable.

Figure 4-3C M2553A/M2554A Termination

4.3 INTERFACE CONNECTOR AND CABLE

Interface Connector:	Circuit Board Edge Connector (gold plated) (designated J-1)
Number of pins/pitch:	34-pins/2.54mm pitch (17-pins each side)
Mis-insert protection:	Key slot between pins 4 and 6
Cable Connector:	Fujitsu - CN-767J034-AL/X 3M - Sumitomo 3463-0001 AMP - Nihon 583616-1 or equivalent
Maximum Cable length:	150 inches (3.0 meters) maximum total cable length - even when using a Daisy Chain connection and more than one disk drive
Pin Designation:	As shown in Table 4-1

Table 4-1 Interface Signal-Pin Designation

Signal Name	Direction	Signal-Pin Number	Return-Pin Number
LOW SPEED*/DISK SENSE**	In/Out	2	1
IN USE***/HEAD LOAD***	Input	4	3
DRIVE SELECT 3	Input	6	5
INDEX PULSE	Output	8	7
DRIVE SELECT 0	Input	10	9
DRIVE SELECT 1	Input	12	11
DRIVE SELECT 2	Input	14	13
MOTOR-ON	Input	16	15
DIRECTION SELECT	Input	18	17
STEP	Input	20	19
WRITE DATA	Input	22	21
WRITE GATE	Input	24	23
TRACK 00	Output	26	25
WRITE PROTECT	Output	28	27
READ DATA	Output	30	29
SIDE ONE SELECT	Input	32	30
READY/DISK CHANGE****	Output	34	33

* = Input available on the M2554A
** = Output available on the M2553A
*** = Input available on the M2553A or M2554A
**** = Output available on the M2553A or M2554A

4.4 INPUT CONTROL SIGNALS

Input, output and data timing relationships are shown in paragraph 4.7.

4.4.1 LOW SPEED/DISK TWO SENSE (Pin 2)

In the M2554A this is the LOW SPEED input signal pin (when the internal LSP jumper is installed). This signal allows the host system to set spindle motor speed at 300 RPM - with a low input signal - or 360 RPM - with a high input signal.

In the M2553A this is the DISK TWO SENSE output signal pin (when the internal jumper 1S or 2S/2D is installed). A high output signal indicates a single sided diskette is being used and a low output signal indicates a double sided double density diskette is being used. See paragraph 4.5.1 for additional information.

In the M2552A or M2551A this is an unused pin.

Refer to Figure 4-4. Three jumper positions are connected to this pin:

LSP (Low Speed) - **With a M2554A,** when the LSP jumper is installed a Low input signal level sets 300 RPM and a High input signal level sets 360 RPM on the spindle motor.

1S (Single Sided) and 2S/2D (Double Sided/Double Density) - **With a M2553A,** used as an output signal to indicate Single Sided or Double Sided/Double Density media as described in paragraph 4.5.1.

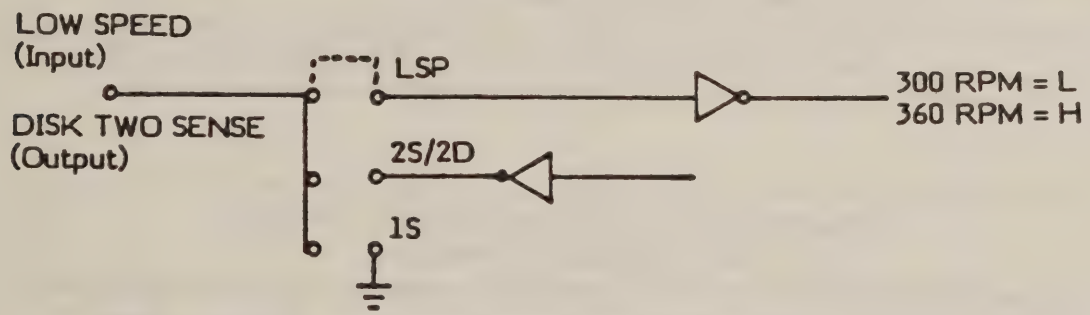


Figure 4-4 LOW SPEED/DISK TWO SENSE Jumper

4.4.2 IN USE/HEAD LOAD (Pin 4)

In the M2551A and M2552A this is an unused pin.

In the M2553A or M2554A this input signal (with the use of internal jumpers) determines either IN USE or HEAD LOAD function.

IN USE places the disk drives connected in the daisy chain, under the control of the host system and (with the LD, U1, U2, LR and DL internal jumpers) determines when the IN USE LED, on the front of each disk drive, is lit as shown in Table 4-2.

HEAD LOAD (with the HS, HM and HL internal jumpers) determines the conditions for loading the heads as shown in Table 4-3.

HEAD LOAD function is executed only when a diskette is inserted and the MOTOR-ON signal is true.

Head Loading is stabilized and data may be transferred, when the disk drive is READY, within 50 milliseconds after HEAD LOAD.

HEAD LOAD is cancelled (Head is unloaded) within 0.5 seconds after the conditions for HEAD LOAD become false.

Table 4-2 LD, U1, U2, LR, DL Jumpers & IN USE LED
(Reference Paragraph 4.4.2)

Jumper					IN USE LED
LD	U1	U2	LR	DL	
IN	OUT	OUT	OUT	OUT	Lit when DRIVE SELECT signal is true
OUT	IN	OUT	OUT	OUT	Lit when IN USE signal is true
IN	IN	OUT	OUT	OUT	Lit when DRIVE SELECT or IN USE signal is true
OUT	OUT	IN	OUT	OUT	Lit by leading edge of DRIVE SELECT signal - when IN USE signal is true Turned Off by leading edge of DRIVE SELECT signal - when IN USE signal is false
OUT	OUT	OUT	IN	OUT	Lit when DRIVE SELECT signal and the internal READY signal is true
OUT	OUT	OUT	OUT	IN	Lit when the door is locked

Table 4-3 HS, HM, HL Jumpers & HEAD LOAD
(Reference Paragraph 4.4.2)

Jumper			HEAD LOAD Function
HS	HM	HL	
IN	OUT	OUT	Executed when the DRIVE SELECT signal is true
OUT	IN	OUT	Executed when the MOTOR-ON signal is true
OUT	OUT	IN	Executed when the HEAD LOAD signal is true

Table 4-4 MS and MM Jumpers & MOTOR CONTROL
(Reference Paragraph 4.4.4)

Jumper		MOTOR CONTROL Function
MS	MM	
IN	OUT	Motor-On with Drive Select Line
OUT	IN	Motor-On with Motor-On Line

4.4.3 DRIVE SELECT 0-3 (DS0=Pin 10, DS1=Pin 12, DS2=Pin 14, DS3=Pin 6)

Refer to Figure 4-3 (shown on page 4-2). There are four DRIVE SELECT lines (DS0, DS1, DS2, and DS3). Only one DRIVE SELECT line may be set true at any time.

The DRIVE SELECT Jumper, located on top of the circuit board near the J-1 connector, determines which DRIVE SELECT line activates the interface for each disk drive. All M255XA Disk Drives are shipped with the DRIVE SELECT jumper installed in the DS0 (DRIVE SELECT-0) position.

When the host system sets a DRIVE SELECT signal line Low (True) the drive, with a jumper installed in that DRIVE SELECT line, has its interface signals connected to the host system cable (via connector J-1).

With a M2551A or M2552A, the IN USE LED on the front of the selected drive will be lit. With a M2553A or M2554A, the IN USE LED on the front of the selected drive will be lit as described in paragraph 4.4.2 and listed in Table 4-2.

4.4.4 MOTOR-ON (Pin 16)

This option is not available in the M2551A or M2552A.

Refer to Table 4-4. Starts the spindle motor when set true by the host system.

Spindle motor speed is stabilized within 400 milliseconds from the leading edge of the MOTOR-ON signal.

4.4.5 DIRECTION SELECT (Pin 18)

Defines the direction of Read/Write head carriage movement (the Read/Write head carriage moves only with each STEP signal pulse).

When this signal is low, the carriage will move inwards (towards an inner track). When this signal is high the carriage will move outwards (towards an outer track).

4.4.6 STEP (Pin 20)

Moves the Read/Write head carriage one track for each STEP pulse. Minimum pulse width is 0.8 microseconds. Head carriage movement is initiated at the end (low to high) edge of the pulse.

If the head carriage is in motion, 3 milliseconds minimum is required between pulses (6 milliseconds for the M2551A). To change the direction of movement, 18 milliseconds minimum is required between pulses (21 milliseconds for the M2551A).

Head Settling is completed within 18 milliseconds (21 milliseconds for the M2551A) after the last STEP pulse.

STEP pulse is invalid if WRITE GATE is true and WRITE PROTECT is false (write and move); or if TRACK 00 is true and DIRECTION SELECT is high (outward step).

4.4.7 SIDE ONE (HEAD) SELECT (Pin 32)

Selects the Read/Write head. When this signal is low, the top (side 1) head is selected. When this signal is high, the bottom (side 0) head is selected.

4.5 OUTPUT CONTROL SIGNALS

Input, output and data timing relationships are shown in paragraph 4.7.

4.5.1 LOW SPEED/DISK TWO SENSE (Pin 2)

In the M2552A or M2551A this is an unused pin.

In the M2554A this is a LOW SPEED input signal pin (when the internal LSP jumper is installed). This signal allows the host system to set spindle motor speed at 300 RPM - with a low input signal - or 360 RPM - with a high input signal. See paragraph 4.4.2 for additional information.

In the M2553A this is the DISK TWO SENSE output signal pin (when the internal jumper 1S or 2S/2D is installed).

With jumper 2S/2D installed, a high DISK TWO SENSE output signal on this pin indicates that a single sided diskette is being used.

With jumper 2S/2D installed, a low DISK TWO SENSE output signal indicates that a double sided double density diskette is being used.

With jumper 1S installed the DISK TWO SENSE output signal is always low.

4.5.2 INDEX (Pin 8)

INDEX is a low going pulse (1 to 8 milliseconds in duration), provided once per disk revolution (each 200 milliseconds at 300 RPM and each 166.6 milliseconds at 360 RPM). The INDEX pulse indicates the beginning of a data track.

The first valid INDEX pulse (high to low leading edge transition) occurs a minimum of 400 milliseconds after the MOTOR-ON signal is set true.

INDEX is also set true (Low) when there is no diskette in the disk drive.

4.5.3 TRACK 00 (Pin 26)

Provided when the Read/Write heads are positioned at the outermost data track.

The TRACK 00 signal is valid within 1.0 millisecond after DRIVE SELECT and within 2.8 milliseconds (5.6 milliseconds with the M2551A) after the STEP signal that positioned the heads at TRACK 00.

4.5.4 WRITE PROTECT (Pin 28)

Provided when a diskette, with its Write Protect Tab installed, is inserted into the drive. Writing is inhibited (by the disk drive) when this signal is true. This signal is valid within 1.0 millisecond after DRIVE SELECT.

4.5.5 READY/DISK CHANGE (Pin 34)

Refer to Figure 4-5 on the following page.

In the M2551A or M2552A this signal indicates the READY status of the disk drive.

4.5.5 READY/DISK CHANGE (Pin 34) - Continued

In the M2553A or M2554A this interface pin (with internal jumpers) indicates either READY status (RY jumper installed) or DISK CHANGE status (DC jumper installed).

The READY signal is true when the disk drive is ready to seek, read or write. This signal is set true within 1.0 second after MOTOR-ON signal is true providing:

1. Power is correctly applied.
2. A diskette is inserted.
3. Disk rotation is 90% of nominal speed and two INDEX pulses have been received.

The DISK CHANGE signal indicates that a diskette has been removed from the disk drive. The DISK CHANGE signal is set true when power is turned on, or when the diskette has been removed

The DISK CHANGE Signal will be set false when:

1. Power is turned on and a diskette is inserted.
2. Internal jumper DSR is installed and DRIVE SELECT signal goes false.
3. Internal jumper STR is installed and STEP signal goes false.

The RR (Radial Ready) or DR (Daisy Chain Ready) jumper must also be installed.

When the RR jumper is installed the READY or DISK CHANGE signal is always supplied to the interface - regardless of the state of the DRIVE SELECT signal.

When the DR jumper is installed the READY or DISK CHANGE signal is supplied to the interface only when the DRIVE SELECT signal is set true.

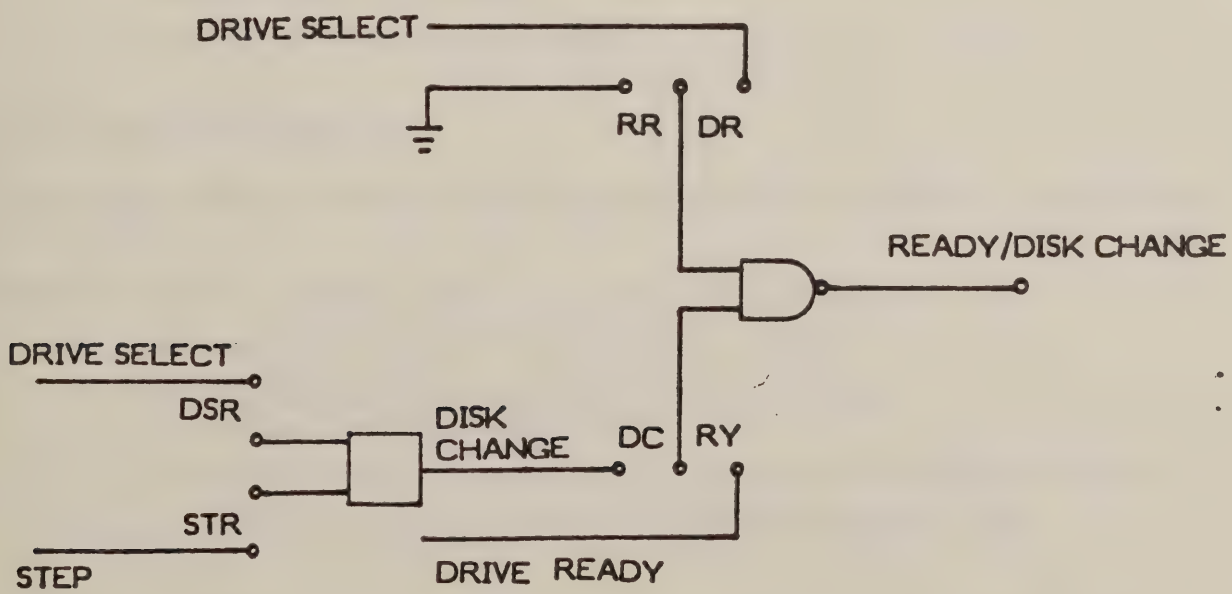


Figure 4-5 READY/DISK CHANGE and Associated Jumpers

4.6 DATA TRANSFER SIGNALS

Input, output and data timing relationships are shown in paragraph 4.7.

4.6.1 WRITE GATE (Pin 24)

Erases old data and permits new data to be written.

This signal is invalid when the WRITE PROTECT signal is true.

The following prerequisites must be set before WRITE GATE will change to the true level:

Drive READY signal must be true

18 milliseconds has elapsed since the last STEP pulse
(21 milliseconds with the M2551A)

100 milliseconds has elapsed since the last SIDE ONE SELECT change

At least 1.4 milliseconds must elapse, after this signal is set false, before:

Stopping the Spindle motor (MOTOR-ON set false)

Changing the selected disk drive (DRIVE SELECT false)

Starting head movement (STEP pulse set true)

Changing the Read/Write head (SIDE ONE SELECT change)

4.6.2 WRITE DATA (Pin 22)

Pulse width of 0.2 to 1.1 microseconds that defines data transitions to be written on the track.

The front end of the pulse is used. This signal is only valid when:

WRITE GATE is true (Low)

WRITE PROTECT is false (High)

4.6.3 READ DATA (Pin 30)

Pulses that define the clock and data pulses (intermixed) read from a pre-recorded data track.

The front end of the pulse is used. This signal is only valid when:

Selected Disk Drive's READY signal is set true

18 milliseconds has elapsed since the last STEP pulse
(21 milliseconds with the M2551A)

100 milliseconds has elapsed since the last SIDE ONE SELECT change

1.4 milliseconds has elapsed since WRITE GATE was set false

4.7 SUMMARY OF M2553A/M2554A JUMPER OPTIONS

The following jumpers are only applicable to the M2553A or M2554A.

DS 0-3 = Drive Select

TD = Terminator for Drive Select (M2552A and M2554A Only)

MX = All drives selected

LD = In-Use LED lit with Drive Select

U1 = In-Use LED lit with In-Use Line, pin-4

U2 = In-Use LED lit with Drive Select and In-Use Line, pin-4

LR = In-Use LED lit with Drive Select and Ready

DL = In-Use LED lit with Door Lock, pin-4

HS = Head Loaded with Drive Select

HM = Head Loaded with Motor-On Line, pin-16

HL = Head Loaded with Head Load Line, pin-4

MS = Motor-On with Drive Select

MM = Motor-On with Motor-On Line. pin-16

M1 = Low Speed, Latched with Drive Select, pin-2

M2 = Low Speed, Unlatched, pin-2

M3 = Override Function Select 0

M4 = Override Function Select 1

DSR = Disk Change Reset with Drive Select

STR = Disk Change Reset with falling edge of Step

DC = Enables Disk Change to pin-34

RY = Enables Ready to pin-34

FS 0-3 = Function Select Jumpers, which control timing of Index, Ready, spindle speed, erase delay, 2 step automatic return to zero, etc.

STRAPS 1-5 = Not Applicable

DI = Index gated with Latched Index

IR = Index gated with Ready

DR = Enable Disk Change or Ready to pin-34 with Drive Select

RR = Enable Disk Change or Ready to pin-34 independent of Drive Select

LSP = Enable Low Speed, pin-2 input

DTS = Enable 2S or 1S, pin-2 output

2S = Enables sense output for 2-sided double density

1S = Enables sense output for 1-sided

4.8 MODIFICATION OF DRIVE FOR USE WITH IBM PC/AT

Instructions for modifying a M2552A Disk Drives are not applicable.

Modify a M2551A Circuit Board for use with an IBM PC/AT as follows:

Refer to Figure 4-6.

1. Move the Drive Select Jumper from DS0 to DS1.
2. Disable the electrical connection at pin-34 by either:
   a. Placing tape over pin-34 (preferred method).
   OR
   b. Cutting the circuit trace at pin-34.

Note: Resistor Packs are not removable. On drives with 300 Ohm Terminating Resistors, ensure there are no more than two drives on a Daisy Chain.

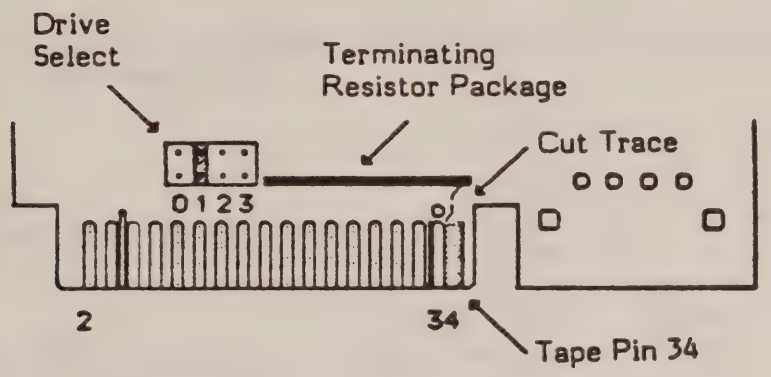


Figure 4-6 Modification of a M2551A for use with an IBM PC/AT

Modify a M2553A Circuit Board for use with an IBM PC/AT as follows:

Refer to Figure 4-7 (on the following page).

1. Move the Drive Select Jumper from DS0 to DS1.
2. Move the In-Use LED Jumper from U2 to LD.
3. Move Jumper DTS to LSP.
4. Move Jumper RY to DC.
5. Move Jumper FS2 to STR.
6. Move Jumper DI to IR.
7. Move Strap 3-4 to 4-5.
8. Move Strap 1-2 to 2-3.

4.8 MODIFICATION OF DRIVE FOR USE WITH IBM PC/AT (Continued)

Modify a M2554A Circuit Board for use with an IBM PC/AT as follows:

Refer to Figure 4-7.

1. Move the Drive Select Jumper from DS0 to DS1.
2. Move the In-Use LED Jumper from U2 to LD.
3. Move Jumper RY to DC.
4. Move Jumper FS2 to STR.
5. Move Jumper DI to IR.
6. Move Strap 3-4 to 4-5.
7. Move Strap 1-2 to 2-3.

Note: When two drives are in the system, remove the terminator pack at RA1 for the first drive in the Daisy Chain.

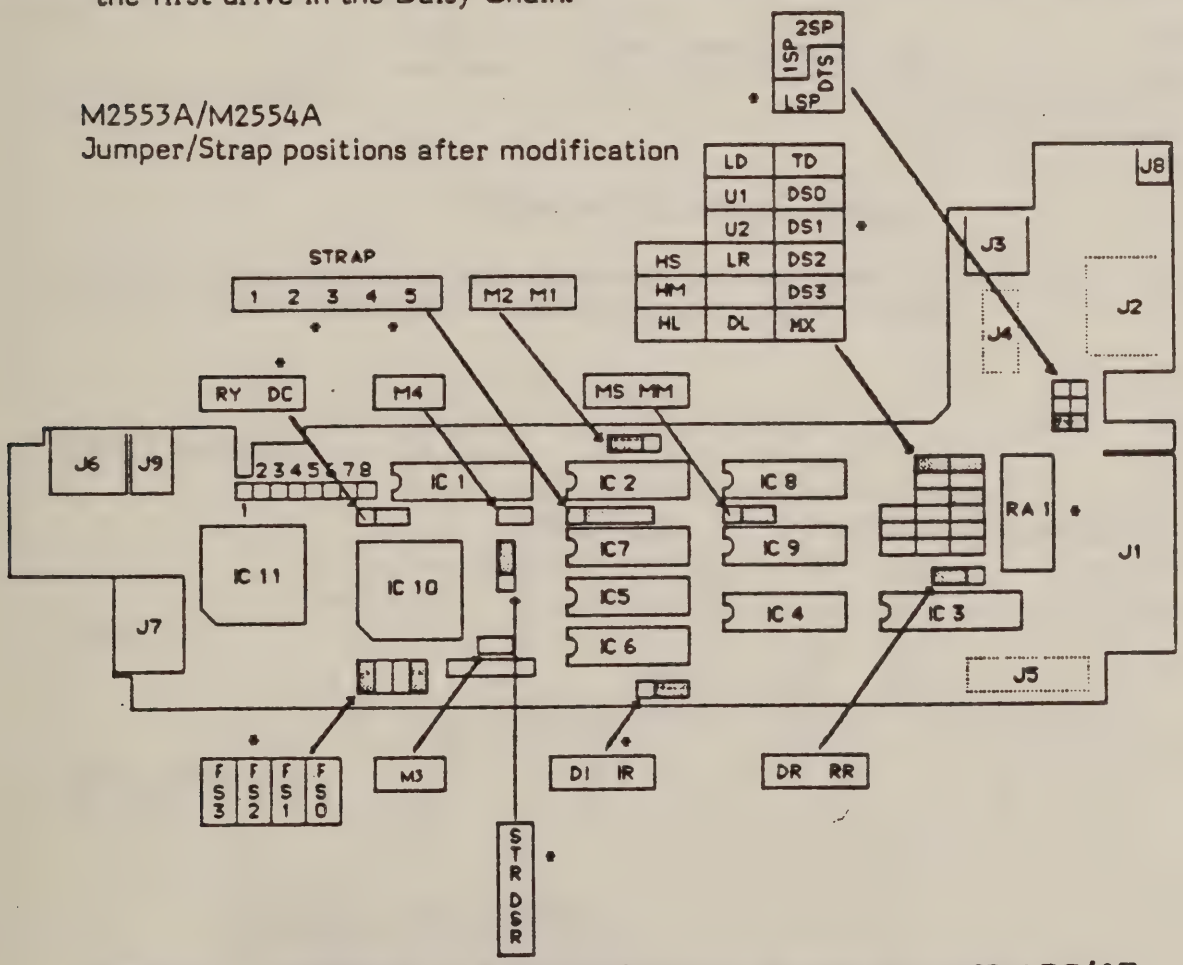


Figure 4-7 Modification of a M2553A/M2554A for use with an IBM PC/AT

4.9 TIMING RELATIONSHIPS

Figure 4-8 shows the timing relationship of the I/O (Input/Output) Control signals.

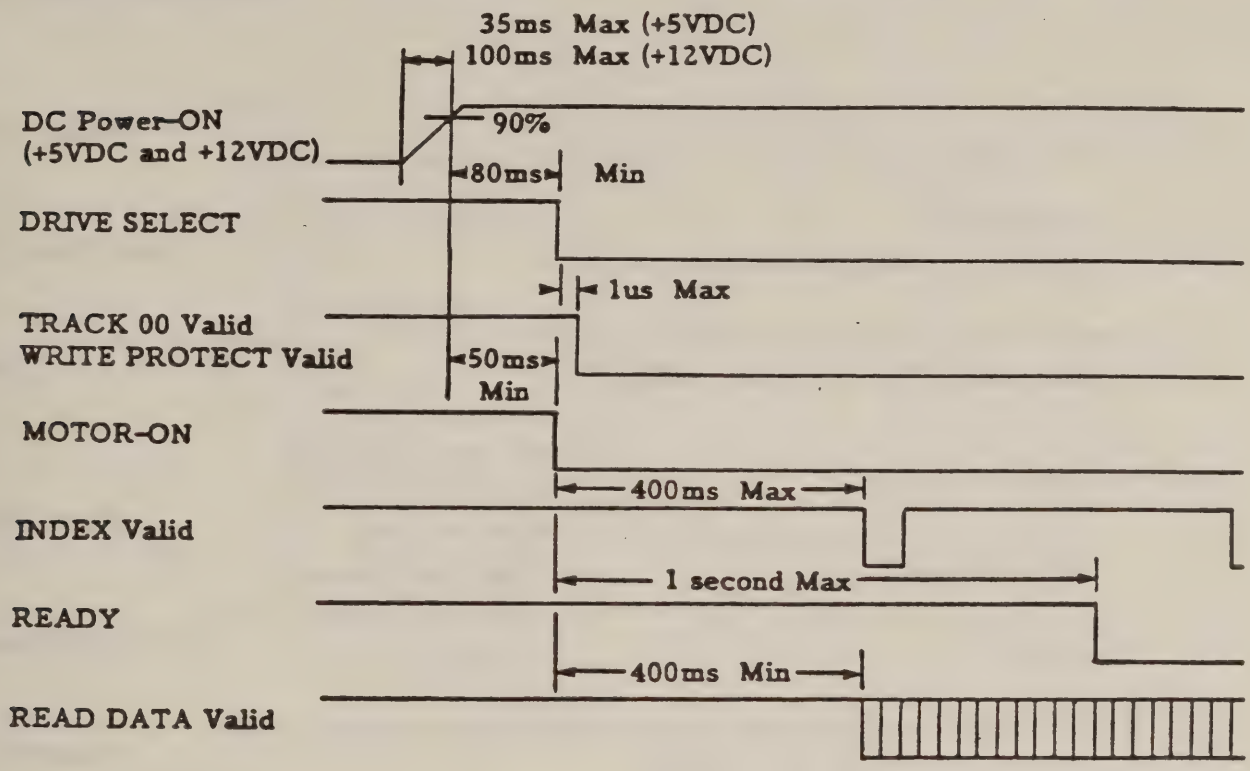
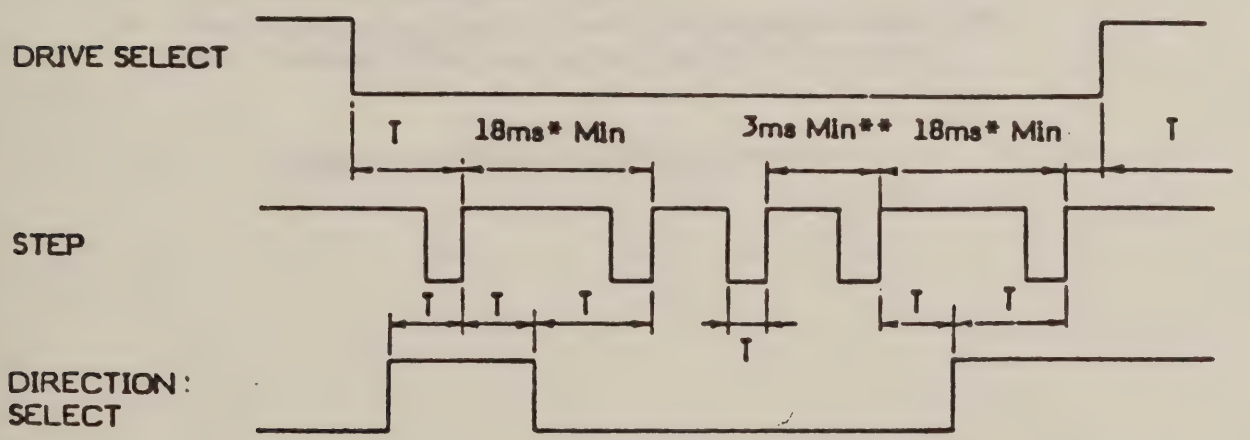


Figure 4-8 I/O Control Timing

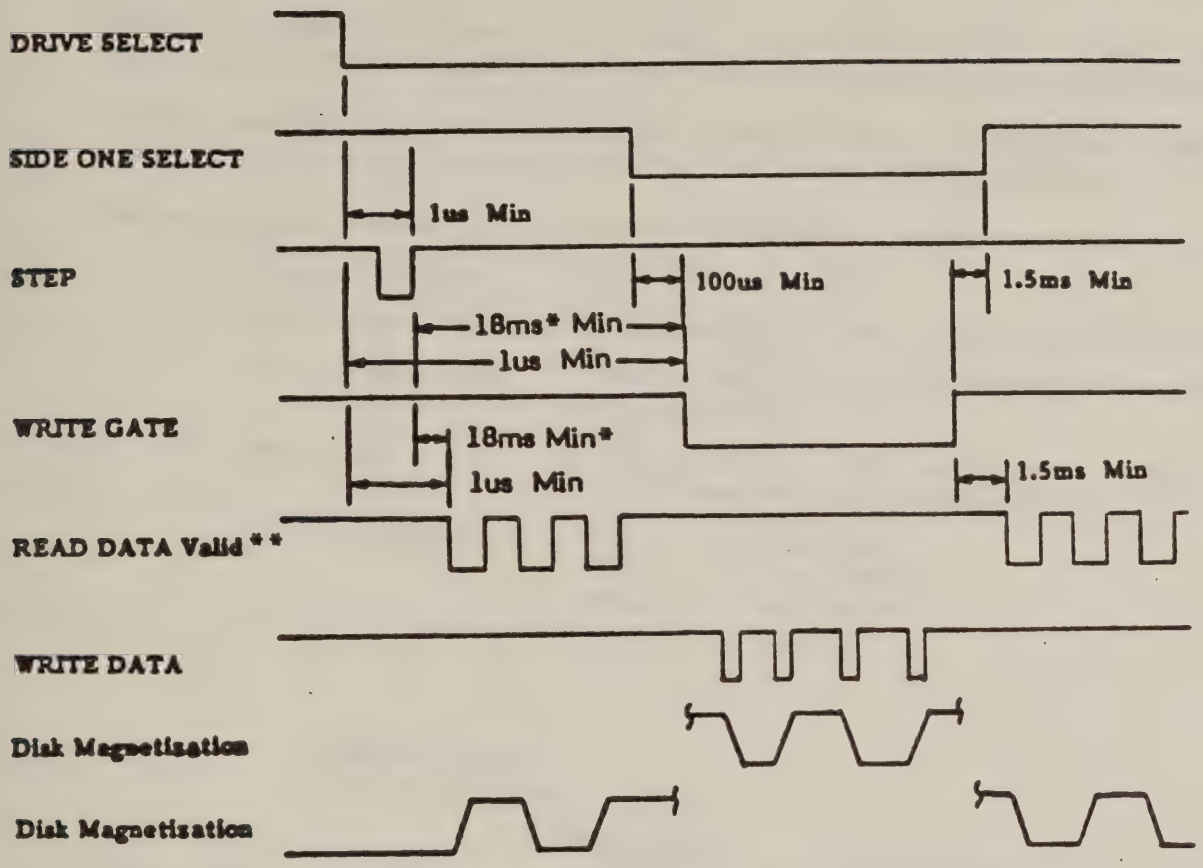
Figure 4-9 shows the timing relationship between the DRIVE SELECT, DIRECTION SELECT and STEP signals (for moving the Read/Write heads).



T = 1 microsecond minimum
* 21 milliseconds with M2551A
** 6 milliseconds with M2551A

Figure 4-9 STEP Signal Timing

Figure 4-10 shows the necessary events and timing restrictions for Read/Write data transfer operations.



* 21ms Minimum with the M2551A
** The leading edge of each pulse will be detected within ±20% from the edge of the pulse to the interval of the pulse.

Figure 4-10 Read/Write Data Transfer

4.10 POWER SUPPLY INTERFACE

Only +12 and +5 Volts DC are required and no input sequence is required.

Frame Ground is normally connected to Signal Ground (Directly connected in the M2551A or M2552A, and connected through a 100K Resistor and a Capacitor in the M2553A or M2554A).

Refer to Section 3 (Figure 3-1). Isolate Frame Ground from Signal Ground by using plastic screws and washers to fasten the drive's circuit board to its frame.

If Frame and Signal Ground are isolated, use the frame mounting hole (tapped for a M3 bolt at the rear of the disk drive) for the Frame Ground connection.

The power supply connector is located on the bottom of the circuit board.

Number of pins:	4 - See Figure 4-11
Mis-insert Protection:	Provided by the shape of the connector housing
Cable Connector:	AMP - 1-480424-0 with pins 60617-1 or 60619-1, or equivalent
Wire size:	#18 AWG, or wire sufficient to handle the drive's maximum power consumption
Pin Designation:	Pin-1 = +12 Volts DC Pin-2 = +12 Volt Return Pin-3 = +5 Volt Return Pin-4 = +5 Volts DC

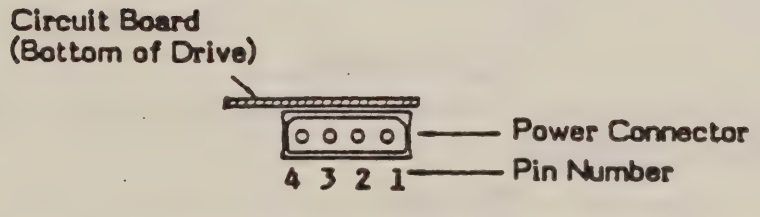


Figure 4-11 Power Supply Connector

The power supply must reach 90% of the +12 Volt level (10.8 Volts) within 100 milliseconds and 90% of the +5 Volt level (4.5 Volts) within 35 milliseconds.

Refer to Figure 4-12 for Power Supply timing relationships.

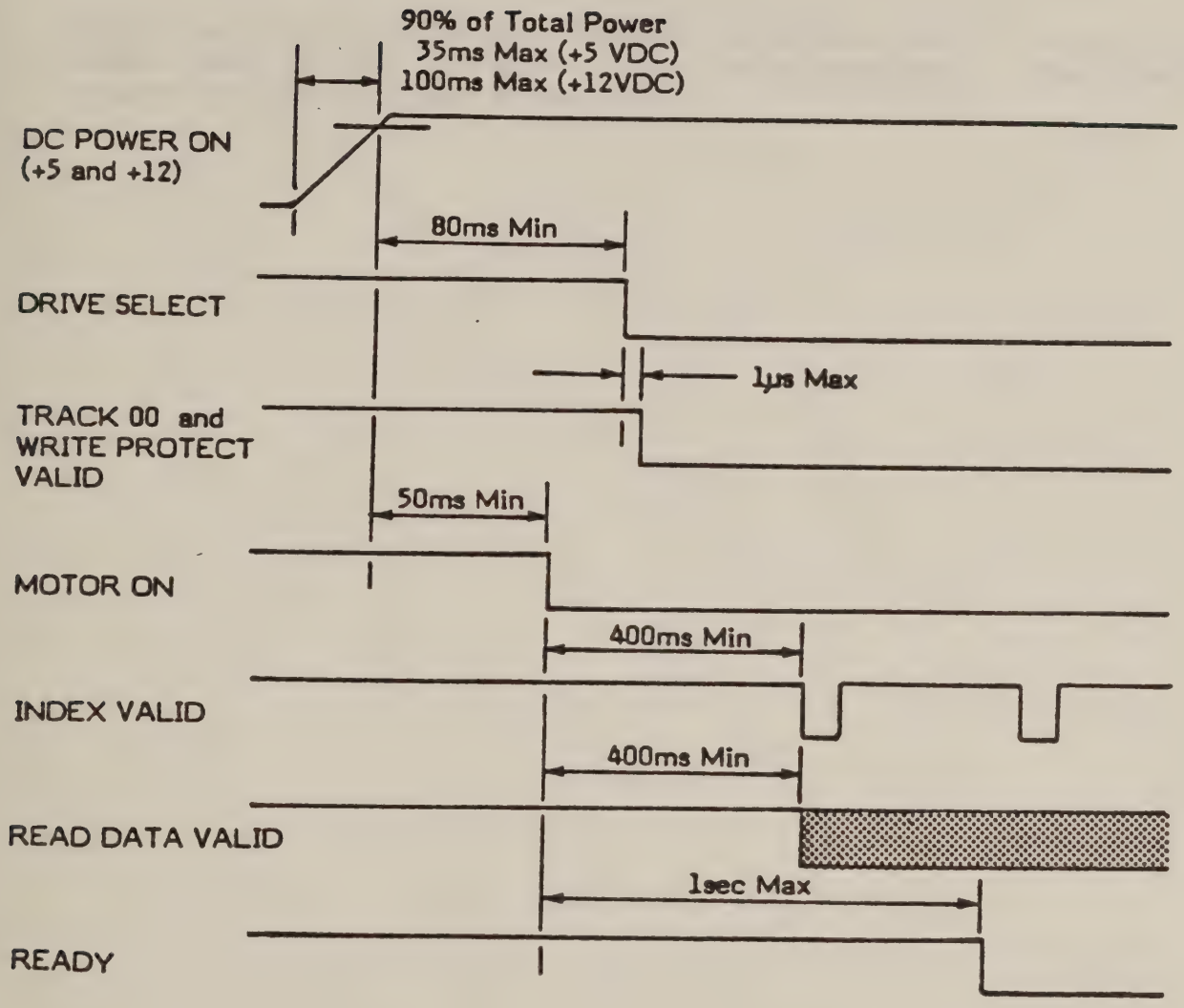


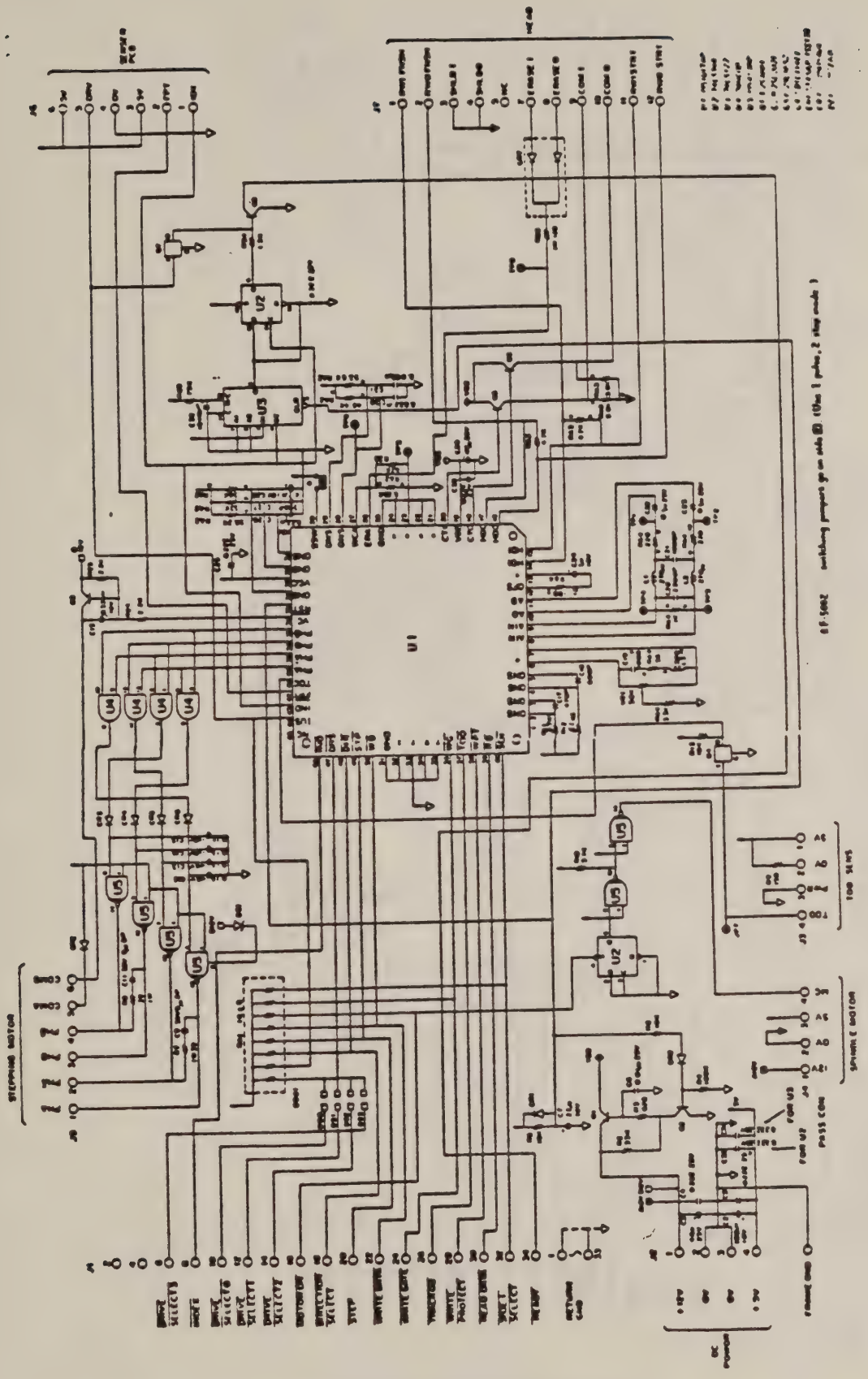
Figure 4-12 Power Supply Timing

SECTION 5

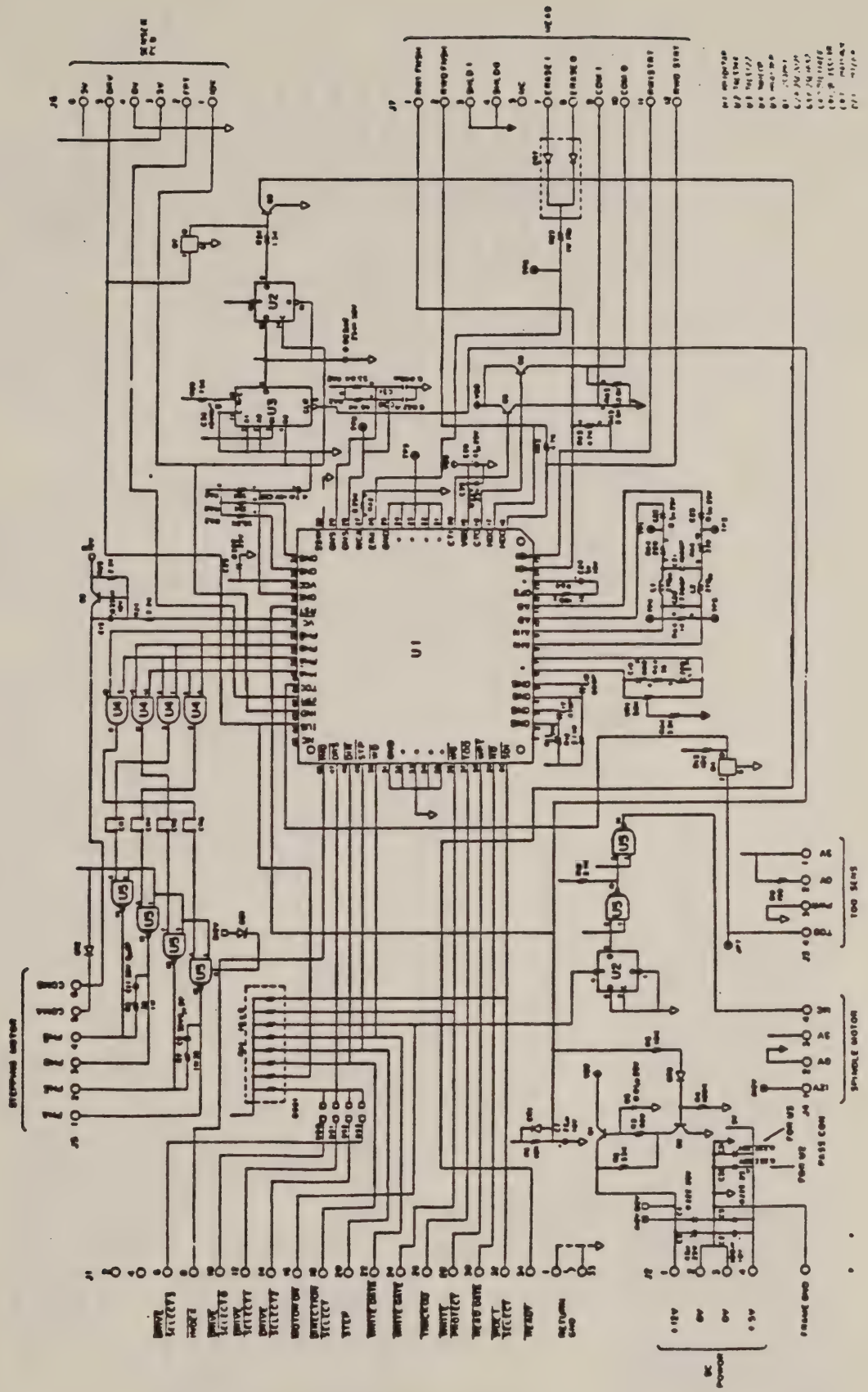
SCHEMATIC DRAWINGS

5.1 INTRODUCTION

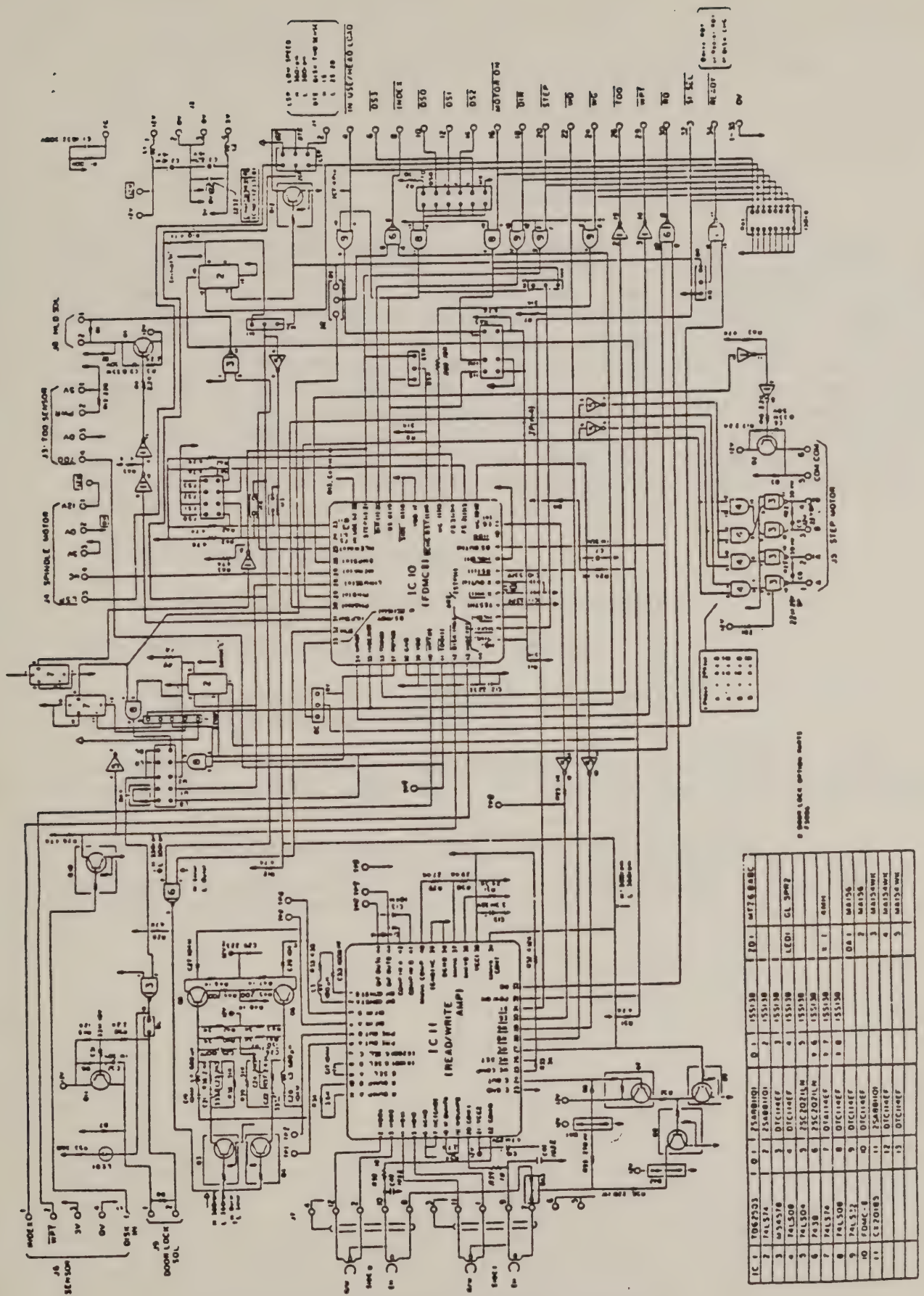
The following schematic drawings represent the revision level of the main circuit board in each M255XA Disk Drive at the time of publication. These schematic drawings should be used for reference only.



M2551A Schematic Drawing



M2552A Schematic Drawing



M2553A and M2554A Schematic Drawing

FCC STATEMENT

This equipment generates and uses radio frequency energy and if not installed and used properly, in strict accordance with the manufacturer's instructions, may cause interference to radio and television reception. This equipment has been type tested within a Class B Personal Computer System and the Computer System has been found to comply with the limits for a Class B computing device in accordance with the specifications in Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures.

- o Reorient the receiving antenna.
- o Relocate the computer with respect to the receiver.
- o Move the computer away from the receiver.
- o Plug the computer into a different outlet, so the computer and receiver are on different branch circuits.

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet helpful:

"How to Identify and Resolve Radio-TV Interference Problems".

This booklet is available from the U.S. Government Printing Office, Washington, DC 20404. Stock number 004-000-00345-4.

MiniScribe

3000 PLUS Series

NOW 53 MSEC. ACCESS

12.75-38.4 MByte 5.25" Winchester Disk Drives

As the market demands faster access time in half-height Winchesters, MiniScribe meets the challenge with its 3000 PLUS Series. A major supplier of half-height Winchester disk drives, the company has developed this series with a faster stepper motor to achieve a 53 millisecond average access time, defeating the industry average of 65 milliseconds in similar capacities. Completing the innovative characteristics of these drives are the self-regulated head parking feature, rugged shock and vibration performance, and a tri-colored LED.

Each model of the 3000 PLUS series — the 3212 PLUS, 3425 PLUS and 3438 PLUS — is characterized by its own unique configuration. The 3212 PLUS features a two-head design with 12.75 MBytes of unformatted storage capacity on a single disk. The 3425 PLUS has a two-disk, four-head MFM 25.6-MByte configuration. The 3438 PLUS, also designed with two disks and four heads, features 38.4 MBytes of storage capacity for 2, 7 RLL compatible applications.

Like other MiniScribe products, the 3000 PLUS series incorporates the company's high standards of quality, innovation, and technical leadership. The drives' self-regulated head parking automatically parks the head at the landing zone following 30 seconds of non-activity, a feature which protects the heads and media from damage, and insures the operator that they are parked in a nondata area. The tri-colored LED allows the operator to view various operational phases of the disk drive: a green light for normal operation, a blinking red light for error codes, and an orange light while the heads are parked at the landing zone.

In addition to the 3000 PLUS Series, MiniScribe produces a complete line of 3½-inch Winchester disk drives beginning at 20 MBytes and extending to high-capacity, high-performance models. MiniScribe's tradition of excellence continues to lead the industry in Winchester disk drive technology.

MiniScribe

3000 PLUS Series

3000 PLUS Series Specifications

Model	3438 PLUS	3425 PLUS	3212 PLUS
Capacity Unformatted			
Per Track (Bytes)	38.4	25.6	12.75
Per Drive (MBytes)	15,624	10,416	10,416
Capacity Formatted			
Per Drive (MBytes)	32.7	21.4	10.7
Per Track (Bytes)	13,312	8,704	8,704
Per Sector (Bytes)	512	512	512
Sectors per track	26	17	17
Functional			
Disks	2	2	1
R/W Heads	4	4	2
Cylinders	615	615	615
Total Data Tracks	2,460	2,460	1,224
Track Density (tpi)	588	588	588
Recording Density	15,048	10,030	10,030
Areal Density (Mbits/sq. in.)	8.85	5.90	5.90
Rotational Speed (RPM)	3,600	3,600	3,600
Data Transfer Rate			
Mbits per Second	7.5	5.0	5.0
Recording Method	2,7 RLL	MFM	MFM
Access Time (Including Settling)			
Average (msec.)	53		
Track-to-Track	15		
Maximum (msec.)	106		
Latency (msec.)	8.33		
Interface	ST412		
Reliability			
MTBF	20,000 Hours		
PM	None		
MTTR	30 Minutes		
Component Design Life	5 Years		

Error Rates	
Soft Read Errors	1 per 10^{10} bits transferred
Hard Read Errors	1 in 10^{12} bits transferred
Seek Errors	1 per 10^{6} seeks
DC Power Requirements	
+5V DC ± 5%	0.6 amps typ.
+12V DC ± 5%	1.3 amps typ.
Max. Starting (20 sec.)	3.5 amps
Power Dissipation	18.6 watts
Environmental Limits	
Ambient Temperatures	40°F to 122°F (4°C to 50°C)
Relative Humidity	8% to 80%
Maximum Wet Bulb	78°F (26°C)
Physical	
Height	1.625 in. (41.3 mm)
Width	5.75 in. (101.6 mm)
Depth	8.00 in. (146 mm)
Weight	2.2 lbs. (1.4 kg)

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MiniScribe

6000 Series

Now up to 128MB RLL

32.0-128.0 MByte 5.25" Full-Height Disk Drives

High storage capacity and high performance backed by MiniScribe's reputation for reliability, best describes the company's 6000 family of Winchester disk drives. The 6000 series has been expanded with the introduction of an RLL version disk drive, Model 6128.

The 6000's feature up to 85.3 MBytes of unformatted storage with MFM data encoding and up to 128.0 MBytes of unformatted storage with 2,7 RLL data encoding. All versions feature an average access time of 28 milliseconds. The drives' positioning system uses a rugged linear voice coil actuator that eliminates head skew problems common with other positioning mechanisms. Microprocessor-aided control provides fast, accurate head positioning. In addition, superior head/disk tracking is achieved through the use of Whitney technology head sliders and flexures.

The 6000's dual-chassis construction protects the HDA from shock and vibration to provide excellent protection during adverse operating conditions. With MiniScribe's fail-safe actuator lock, data zone contact at power-down is eliminated by retracting and locking the positioner in a non-data shipping area.

The 6000 family utilizes a patented breather filter system with a recirculating air filter that keeps the 6000's pressurized HDA chamber at a cleanliness level exceeding a Class 100 environment. The drives' IC preamplifier is positioned inside the sealed HDA, close to the recording heads for high-clarity signal processing.

Like all MiniScribe products, the 6000's undergo a rigorous testing and burn-in process before shipment. The MiniScribe line of 3½ inch and 5¼ inch Winchester disk drives begins at 12.75 MBytes and extends to high capacity/high performance models. MiniScribe's tradition of excellence continues to lead the industry in Winchester disk drive technology.

6000 Family Key Features

- Storage Capacity of up to 85.3 MBytes Unformatted with MFM and 128 MBytes unformatted with 2,7 RLL.
- 28 msec. Average Seek Time (including settling)
- 3.25 H X 5.75" X 8.00"L
- Linear Voice Coil Closed Loop Servo System
- 14.1 Watt Standby Power Requirement
- Whitney Technology Flexures and Sliders
- Fail-Safe Automatic Actuator Lock
- Brushless DC Spindle Motor
- Single Printed Circuit Board for Improved Reliability
- 5.0 Mbit/sec. Data Transfer Rate with MFM and 7.5 Mbit/sec. with 2,7 RLL
- ST506/ST412 Compatible Interface

MiniScribe

6000 Series

5.25" Winchester Disk Drive Specifications

Model	6128**	6085	6053	6032
Capacity Unformatted				
Per Drive (MBytes)	128.0	85.3	53.3	32.0
Per Track (Bytes)	15,624	10,416	10,416	10,416
Capacity Formatted				
Per Drive (MBytes)	110.1	71.3	44.6	26.7
Per Track (Bytes)	13,440	8,704	8,704	8,704
Per Sector (Bytes)	512	512	512	512
Sectors Per Track	26	17	17	17
Functional				
Disks	5	5	3	2
Servo Heads	1	1	1	1
R/W Heads	8	8	5	3
Cylinders	1,024	1,024	1,024	1,024
Total Data Tracks	8,192	8,192	5,120	3,072
Track Density (tpi)	1,000	1,000	1,000	1,000
Recording Density (bpi)	14,925	9,950	9,950	9,950
Areal Density (Mbits/sq. in.)	14.925	9.95	9.95	9.95
Rotational Speed (RPM)	3,600	3,600	3,600	3,600
Data Transfer Rate				
(Mbits per second)	7.5	5.0	5.0	5.0
Recording Method	2,7 RLL	MFM	MFM	MFM
Access Time (including settling)				
Average (msec.)*	28			
Track-to-Track (msec.)	6			
Maximum (msec.)	55			
Latency (average, msec.)	8.33			
Interface	ST506/ST412			
Reliability				
MTBF	25,000 POH			
PM	None			
MTTR	30 minutes			
Component Design Life	5 years			

*Average of all possible seeks.
**RLL version also available in 80 MB unformatted capacity.

Error Rates	
Soft Read Errors	1 per 10^{10} bits transferred
Hard Read Errors	1 per 10^{12} bits transferred
Seek Errors	1 per 10^{6} seeks
DC Power Requirements	
+5 V DC ±5%	0.9 amps typical
+12 V DC ±5%	0.8 amps typical 1.8 amps max. seeking
Starting (6 sec.)	4.0 amps max.
Power Dissipation	
Standby	14.1 watts typical
Positioning	26.1 watts max.
Average	18 watts
Environmental Limits	
Ambient Temperatures	
Operating	50°F to 113°F (10°C to 45°C)
Non Operating	−40°F to 140°C (−40°C to 60°C)
Relative Humidity (non-condensing)	
Operating	8% to 80%
Non-Operating	8% to 80%
Maximum Wet Bulb	78°F (26°C)
Physical	
Height	3.25 in. (82.6 mm)
Width	5.75 in. (146 mm)
Depth	8.00 in. (203 mm)
Weight	6 lbs. (2.7 kg)

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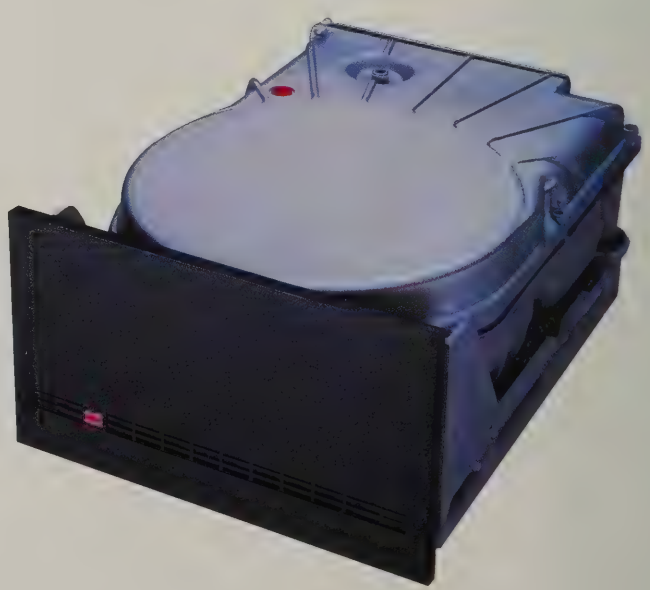

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MiniScribe 3212

12.75 MByte 5.25″ Half-Height Disk Drive

When rugged shock and vibration performance is a necessity, MiniScribe's 3212 half-height is the Winchester disk drive that stands out. With 12.75 MBytes of storage capacity on a single disk, the 3212 features a two-head design with an average access time of 85 milliseconds in half the height of standard 5.25-inch Winchester disk drives.

This model has proven itself, since its 1983 introduction, as one of the workhorses of the portable and desktop computer industry. With a better than 99.6 percent OEM acceptance rate, the 3212 delivers the most favorable cost-per-megabyte solution among half-heights.

As a major supplier of half-height drives, MiniScribe has established a new standard of quality in the industry. The company's rack and pinion actuator provides positioning accuracy throughout temperature extremes. Its patented breather filter system with a recirculating air filter keeps the 3212's pressurized HDA chamber at a cleanliness level exceeding a Class 100 environment. The drive's IC preamplifier is positioned inside the sealed HDA, close to the recording heads for high-clarity signal processing.

The 3212's mounting requirements are identical to half-height 5.25-inch floppy drives. With heat dissipation of only 13 watts, the 3212 requires minimal power for its reliable design. In addition, the drive incorporates the industry standard ST412 interface. For shipping and rugged handling, the 3212's heads can be fixed over a non-data area of the disk until power is applied.

Like all MiniScribe products, the 3212 undergoes a rigorous testing and burn-in process of 96 hours per drive. The MiniScribe line of full and half-height Winchester disk drives begins at 12.75 MBytes and extends to high capacity/high performance models. MiniScribe's tradition of excellence continues to lead the industry in Winchester disk drive technology.

MiniScribe 3212

5.25″ Winchester Disk Drive Specifications

Capacity Unformatted	
Per Drive (MBytes)	12.75
Per Track (Bytes)	10,416
Capacity Formatted	
Per Drive (MBytes)	10.0
Per Track (Bytes)	8,192
Per Sector (Bytes)	256
Sectors Per Track	32
Functional	
Rotational Speed (RPM)	3600
Recording Density (bpi)	10,030
Areal Density (Mbits/sq.in.)	5.9
Track Density (tpi)	588
Total Data Tracks	1,224
Cylinders	612
R/W Heads	2
Disks	1
Data Transfer Rate	
(Mbits per second)	5.0
Access Time (including settling)	
Average (msec.)	85
Track-to-Track (msec.)	15
Maximum (msec.)	190
Latency (average, msec.)	8.33
Interface	ST412
Reliability	
MTBF	10,000 hours
PM	None
MTTR	30 minutes
Component Design Life	5 years

Error Rates	
Soft Read Errors	1 per 10^{10} bits transferred
Hard Read Errors	1 per 10^{12} bits transferred
Seek Errors	1 per 10^{6} seeks
DC Power Requirements	
+5 V DC ±5%	0.75 amps typical
+12 V DC ±5%	0.75 amps typical
Max. Starting (10 sec.)	3.0 amps
Power Dissipation	13 watts
Environmental Limits	
Ambient Temperatures	40°F to 122°F (4°C to 50°C)
Relative Humidity	8% to 80%
Maximum Wet Bulb	78°F (26°C)
Physical	
Height	1.625 in. (41.3 mm)
Width	5.75 in. (146 mm)
Depth	8.00 in. (203 mm)
Weight	3.5 lbs. (1.5 kg)

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MiniScribe

3425/3438

Now up to 38.4MB RLL

25.6-38.4 MByte 5.25" Half-Height Disk Drives

When higher capacity and shock and vibration performance in a half-height was required, MiniScribe met the challenge with its 3425. As a major supplier of half-height Winchester disk drives, the company developed the 3425 into an innovative two disk, four head 25.6 MByte configuration with an average access time of 85 milliseconds.

The 3438 now joins the MiniScribe family of products. This is a 38.4 MByte product designed for *2,7 RLL compatible* applications. This new product further demonstrates MiniScribe's technical leadership by delivering one of the most favorable cost-per-megabyte solutions among half-heights.

Like other MiniScribe products, the 3425/3438 incorporate the company's high standards of quality and innovation. The drive's rack and pinion actuator provides positioning accuracy throughout temperature extremes. The company's patented breather filter system with a recirculating air filter keeps the 3425/3438's pressurized HDA Chamber at a cleanliness level exceeding a Class 100 environment. The 3425/3438's IC preamplifier is positioned inside the sealed HDA, close to the recording heads for high-clarity signal processing.

The 3425/3438's mounting requirements are identical to half-height 5.25-inch floppy drives. With heat dissipation of only 14-14.5 watts, the 3425/3438 require minimal power for their rugged designs. In addition, the drives incorporate the industry standard ST506/ST412 interface. For shipping and handling, the 3425/3438's heads can be fixed over a non-data area of the disk until power is applied.

Like all MiniScribe products, the 3425/3438 undergo a rigorous testing and burn-in process. The MiniScribe line of 3½ inch and 5¼ inch Winchester disk drives begins at 12.75 MBytes and extends to high capacity/high performance models. MiniScribe's tradition of excellence continues to lead the industry in Winchester disk drive technology.

MiniScribe

3425/3438

5.25" Winchester Disk Drive Specifications

Model	3425	3438
Capacity Unformatted		
Per Drive (MBytes)	25.6	38.4
Per Track (Bytes)	10,416	15,624
Capacity Formatted		
Per Drive (MBytes)	21.4	31.4
Per Track (Bytes)	8,704	12,800
Per Sector (Bytes)	512	512
Sectors Per Track	17	25
Functional		
Rotational Speed (RPM)	3,600	3,600
Recording Density	10,030	15,048
Areal Density (Mbits/sq. in.)	5.9	8.85
Track Density (tpi)	588	588
Total Data Tracks	2,460	2,460
Cylinders	615	615
R/W Heads	4	4
Disks	2	2
Data Transfer Rate		
(Mbits per second)	5.0	7.5
Recording Method	MFM	2,7 RLL
Access Time (including Settling)		
Average (msec.)	85	85
Track-to-Track (msec.)	15	15
Maximum (msec.)	190	190
Latency (average, msec.)	8.33	8.33
Interface	ST506/ ST412	ST506/ ST412
Reliability		
MTBF	20,000 hours	
PM	None	
MTTR	30 minutes	
Component Design Life	5 years	

Error Rates	3425	3438
Soft Read Errors	1 per 10^{10} bits transferred	1 per 10^{10} bits transferred
Hard Read Errors	1 per 10^{12} bits transferred	1 per 10^{12} bits transferred
Seek Errors	1 per 10^{6} seeks	1 per 10^{6} seeks
DC Power Requirements		
+5 V DC ±5%	0.4 amps typical	0.5 amps typical
+12 V DC ±5%	1.0 amps typical	1.0 amps typical
Max Starting (10 sec.)	2.9 amps	3.5 amps
Power Dissipation	14 watts	14.5 watts
Environmental Limits		
Ambient Temperatures	40°F to 122°F (4°C to 50°C)	
Relative Humidity	8% to 80%	
Maximum Wet Bulb	78°F (26°C)	
Physical		
Height	1.625 in. (41.3 mm)	
Width	5.75 in. (146 mm)	
Depth	8.00 in. (203 mm)	
Weight	3.5 lbs. (1.6 kg)	
Available in plated or oxide media		

Features and specifications subject to change without notice.
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5¼" Half-Height Kits
25.6 or 38.4. MBytes

3425K
3438K

- **Kit Contents: 25.6/38.4 MByte disk drive, compatible controller board, cable set, hardware, installation guide**
- **Based on MiniScribe's 3000 family of 5¼ inch half-height disk drives**
  - **Low power consumption (14-14.5 watts)**
  - **Field-proven rack and pinion actuator provides positioning accuracy throughout temperature extremes**
  - **Industry standard ST412/506 interface**
- **Custom kit configurations available**
- **Controller board options**
- **Easy installation**
- **Product family growth to faster access times and higher capacities**

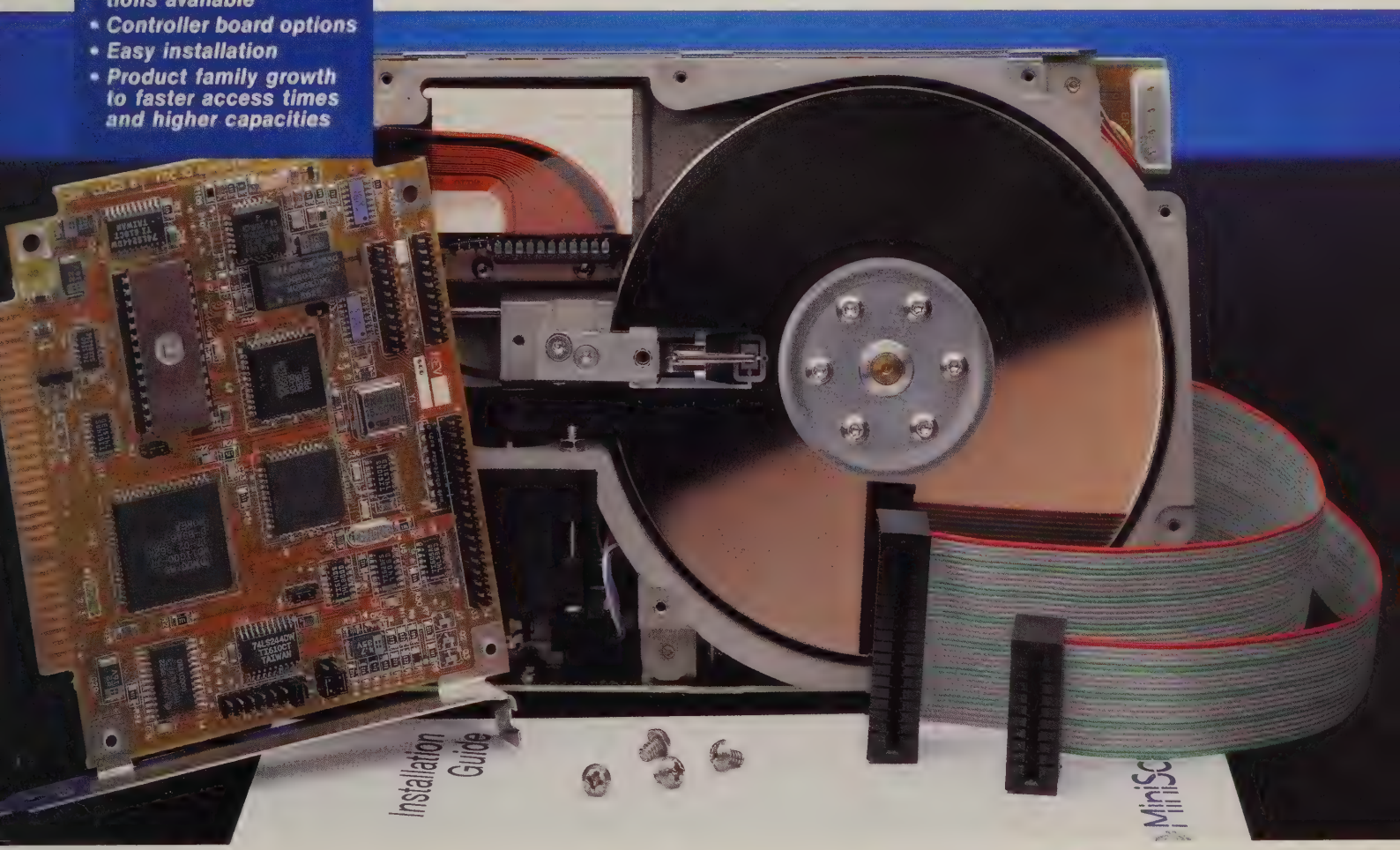
The MiniScribe 3425K/3438K Kit family provides alternatives to adding hard disk storage to single-user and desk-top systems. Featuring controller board options and custom kit configurations, the 3000 Kit family is a complete hard drive upgrade package which includes a 25.6 MByte or 38.4 MByte (unformatted capacity) disk drive, compatible hard disk controller, cable set, hardware and an easy to follow installation guide.

Based on the MiniScribe 3000 family of 5¼" half-height Winchester disk drives, the 3425K/3438K offer an average access time of 85 milliseconds, low power consumption of 14-14.5 watts, and the industry standard ST412/506 interface.

Like other MiniScribe products, the 3425K/3438K incorporate the company's high standards of quality and innovation. Both the 25.6 MByte MFM, model 3425K, and the 38.4 MByte 2,7 RLL, model 3438K, utilize a rack and pinion linear actuator system which provides positioning accuracy throughout temperature extremes as well as rugged resistance to shock and vibration.

With planned enhancements in access times and higher storage capacities, the 3425K/3438K Kit family is the solution to current and future storage requirements.

In addition to the 3000 Kit family, MiniScribe produces a complete line of 3½" and 5¼" Winchester disk drives which begins at 12.75 MBytes, extends to high capacity/high performance models, and includes a variety of standard, intelligent and custom interfaces.



MiniScribe

3425K/3438K Kit Specifications

Model	MFM 3425K	RLL 3438K
Capacity Unformatted		
Per Drive (MBytes)	25.6	38.4
Per Track (Bytes)	10,416	15,624
Capacity Formatted		
Per Drive (MBytes)	21.4	31.4
Per Track (Bytes)	8,704	13,312
Per Sector (Bytes)	512	512
Sectors per Track	17	26
Functional		
Disks	2	3
R/W Heads	4	4
Cylinders	615	615
Total Data Tracks	2,460	2,460
Track Density (tpi)	588	588
Recording Density (bpi)	10,030	15,048
Areal Density (Mbits/sq. in.)	5.9	8.85
Rotational Speed (RPM)	3,600	3,600
Data Transfer Rate		
(Mbits per Second)	5.0	7.5
Recording Method	MFM	2,7 RLL
Access Time (incl. settling)		
Average (msec.)	85	85
Track-to-Track (msec.)	15	15
Maximum (msec.)	190	190
Latency (avg. msec.)	8.33	8.33
Interface	ST412/506	
Reliability		
MTBF	20,000 hours	
PM	None	
MTTR	30 Minutes	
Component Design Life	5 Years	

Model	MFM 3425K	RLL 3438K
Error Rates		
Soft Read Errors	1 in 10^{10} bits transferred	
Hard Read Errors	1 in 10^{12} bits transferred	
Seek Errors	1 per 10^{6} seeks	
DC Power Requirements		
+5V DC +/−5%	0.4 amps typ.	0.5 amps typ.
+12V DC +/−5%	1.0 amps typ.	1.0 amps typ.
Max. Starting (20 sec.)	3.5 amps typ.	3.5 amps typ.
Power Dissipation (Drive Only)	14.5 watts	14.5 watts
Environmental Limits		
Ambient Temp.	40°F - 122°F (4°C to 50°C)	
Relative Humidity	8% - 80%	
Maximum Wet Bulb	78°F (26°C)	
Physical (Drive Only)		
Height	1.625 in. (41.3 mm)	
Width	5.75 in. (146 mm)	
Depth	8.00 in. (203 mm)	
Weight	2.2 lbs. (1 Kg)	

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3425K
3438K

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MiniScribe

50.5 MBytes
5¼" Half-Height Disk Drive

3650

- **Based on MiniScribe's 3000 family of 5¼-inch half-height disk drives.**
  - **Field-proven rack and pinion actuator provides positioning accuracy throughout temperature extremes**
- **50.5 MByte (unformatted)**
- **61 msec. average access time**
- **Self-regulated head parking feature**
- **Tri-colored LED**
- **Product family growth to higher capacities**
- **Industry standard ST412 interface**

Responding to the demand for a higher capacity, cost-effective, 5¼-inch half-height disk drive with increased performance, MiniScribe has met the challenge with its new model 3650. Based on MiniScribe's rugged 3000 family of 5¼-inch half-height Winchester disk drives, the 3650 is an innovative three disk, six head, 50.5 MByte configuration with an average access time of 61 milliseconds.

The 3650 features a tri-colored LED which allows the operator to view various operational phases of the disk drive by displaying a green light during normal operation, a blinking red light for error codes and an amber light while the heads are parked at the landing zone.

Another innovative feature of the 3650 is the self-regulated head parking feature which will automatically park the heads at the landing zone after 30 seconds of inactivity to insure the operator that the heads are parked in a nondata area.

Like other MiniScribe products, the 3650 incorporates the company's high standards of quality and innovation. The 3650 utilizes MiniScribe's field-proven rack and pinion linear actuator system which provides positioning accuracy throughout temperature extremes as well as rugged resistance to shock and vibration. In addition, the drive incorporates the industry standard ST412/506 interface.

With planned enhancements to higher storage capacities, the 3650 demonstrates MiniScribe's technical leadership by delivering one of the most favorable cost per megabyte solutions for your current and future storage requirements.

In addition to the 3650, MiniScribe produces a complete line of 3½-inch and 5¼-inch Winchester disk drives which begins at 12.75 MBytes, extends to high capacity, high performance models, and includes a variety of standard, intelligent and custom interfaces.

MiniScribe

3650 Specifications

Capacity Unformatted	
Per Drive (MBytes)	50.5
Per Track (Bytes)	10,416
Capacity Formatted	
Per Drive (MBytes)	41.9
Per Track (Bytes)	8,704
Per Sector (Bytes)	512
Sectors per Track	17
Functional	
Disks	3
R/W Heads	6
Cylinders	809
Total Data Tracks	4,854
Track Density (tpi)	763
Recording Density (bpi)	10,030
Areal Density (Mbits/sq. in.)	7.65
Rotational Speed (RPM)	3,600
Data Transfer Rate	
(Mbits per Second)	5.0
Recording Method	MFM
Access Time (incl. settling)	
Average (msec.)	61
Track-to-Track (msec.)	15
Maximum (msec.)	132
Latency (avg. msec.)	8.33
Interface	ST412
Reliability	
MTBF	15,000 hours
PM	None
MTTR	30 Minutes
Component Design Life	5 Years

Error Rates	
Soft Read Errors	1 in 10^{10} bits transferred
Hard Read Errors	1 in 10^{12} bits transferred
Seek Errors	1 per 10^{6} seeks
DC Power Requirements	
+5V DC +/−5%	0.6 amps typical
+12V DC +/−5%	1.3 amps typical
Max. Starting (22 sec.)	3.5 amps
Power Dissipation	18.6 watts
Environmental Limits	
Ambient Temp.	40°F - 122°F (4°C to 50°C)
Relative Humidity	8% - 80%
Maximum Wet Bulb	78°F (26°C)
Physical	
Height	1.625 in. (41.3 mm)
Width	5.75 in. (146 mm)
Depth	8.00 in. (203 mm)
Weight	3.1 lbs. (1.4 kg)

Features and specifications subject to change without notice.

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3650

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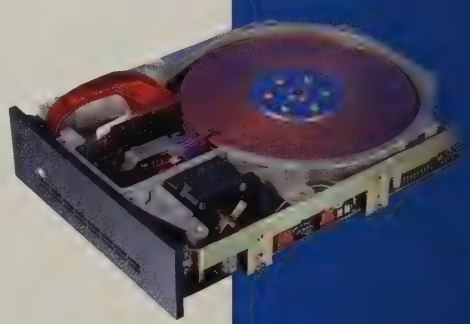

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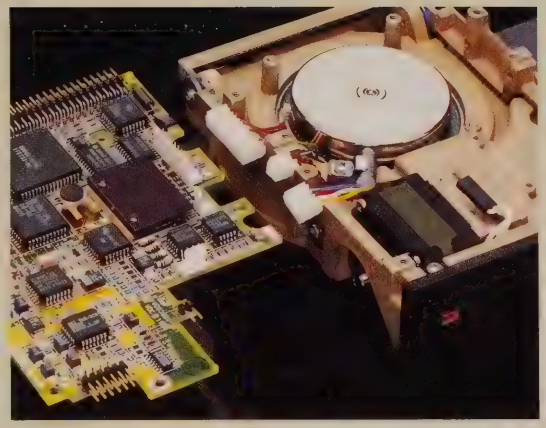

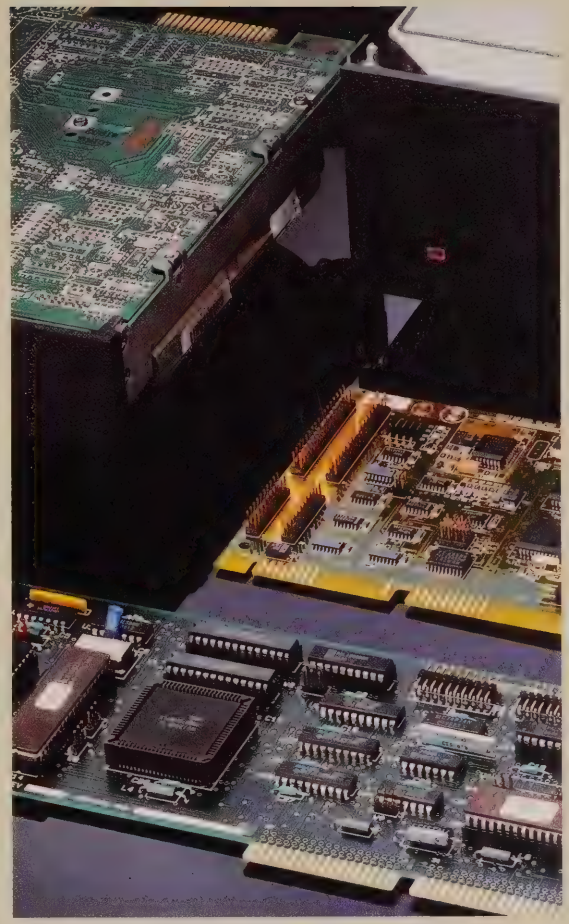

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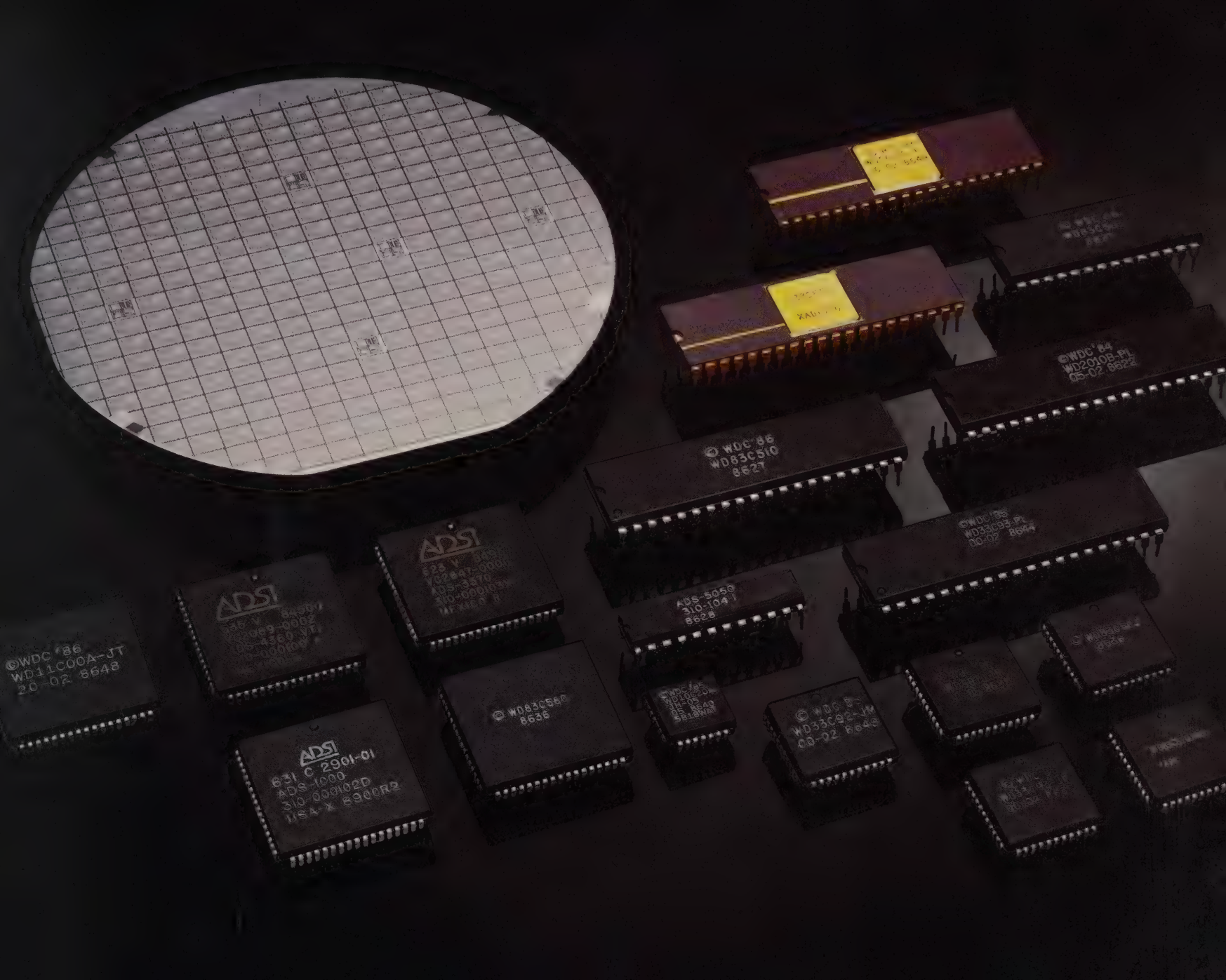
WESTERN DIGITAL

STORAGE MANAGEMENT PRODUCTS

	Part Number	Technical Information	Power Requirements	Package Size	Product Description
Floppy Disk Controller Devices	WD1773-00	Single chip	+5V	28 pins	WD1770 with software compatibility to FD1793.
	WD1772-02	Single chip	+5V	28 pins	WD1772-00 with enhanced digital data separation.
	FD1791	Inverted data bus	+5V, +12V	40 pins	Single/double density, IBM® compatible.
	FD1793	True data bus	+5V, +12V	40 pins	Single/double density, IBM compatible.
	FD1795	Inverted data bus	+5V, +12V	40 pins	Single/double density, double sided.
	FD1797	True data bus	+5V, +12V	40 pins	Single/double density, double sided.
	WD2793	True data bus	+5V	40 pins	FD179X with built-in analog data separator and write precompensation single/double density.
	WD2791	Inverted data bus	+5V	40 pins	
	WD2797	True data bus	+5V	40 pins	FD179X with built-in analog data separator and write precompensation single/double density, and side select out.
	WD2795	Inverted bus	+5V	40 pins	
	WD37C65	Floppy subsystem	+5V	40 pins DIP 44 pins QSM	Complete floppy subsystem. Formatter/controller with an enhanced digital data separator (patent pending) write precomp with special PC XT™ and PC AT™ modes for maximum flexibility.
Floppy Disk Support Devices	WD1691	8" or 5.25" drives	+5V	20 pins	Floppy disk data separator/write precompensation.
	WD16C92A	CMOS	+5V	40 pins	Floppy support device containing PLL logic/clock generation/write precompensation and interrupt/DMA timing for IBM PC AT bus.
	WD2143	2.5 MHz	+5V	18 pins	Four phase clock generator.
	WD9216-01	Single chip	+5V	8 pins	Floppy disk digital data separator.
	WD92C32	CMOS	+5V	8 pins	Enhanced floppy disk digital data separator.
Winchester Disk Controller Devices	WD1010A-05	NMOS, 5 MHz	+5V	40 pin DIP/ 44 pin QSM	ST506 compatible Winchester controller with MFM encode/decode.
	WD1050-10	NMOS, 10 MHz	+5V	68 pin QSM	SMD compatible Winchester controller.
	WD1050-15	NMOS, 15 MHz	+5V	68 pin QSM	SMD compatible Winchester controller.
	WD2010B-05	NMOS, 5 MHz	+5V	40 pin DIP/ 44 pin QSM	ST506 compatible Winchester controller with MFM encode/decode and 32 bit ECC.
	WD5010A-10	NMOS, 10MHz	+5V	40 pin DIP/ 44 pin QSM	ST506/ESDI compatible Winchester controller with 32 bit ECC and MFM and NRZ encode/decode. Needs 50C20A for ESDI.
	WD5011-10	NMOS, 10 MHz	+5V	40 pin DIP/ 44 pin QSM	ST506 compatible Winchester controller with RLL 2,7 encode/decode and 56 bit ECC.
	WD30C30-10	CMOS, 10 MHz	+5V, +12V	40 pin DIP/ 44 pin QSM	ST506 compatible Winchester controller including self-adjusting data separator, 32 bit ECC and MFM encode/decode.
	ADS-1000	NMOS, 15 MHz	+5V	68 pin QSM	Programmable Winchester Disk controller with 48 Bit ECC and NRZ data.
	WD10C00	CMOS, 24 MHz	+5V	68 pin QSM	CMOS compatible version of ADS-1000.
Winchester Disk Support Devices	WD10C20A-05	CMOS, 5 MHz	+5V, +12V	28 pin DIP/QSM	Self-adjusting data separator and write precompensation device for MFM data. Compatible with the WD1010, WD2010 and WD5010 devices.
	WD50C12	CMOS, 15 MHz	+5V	40 pin DIP/ 44 pin QSM	ST506 compatible Winchester controller with MFM, RLL.

PHOTO: Western Digital's newest VLSI semiconductor controllers offer a high level of functional integration. Most are available in both DIP and SMT plastic packages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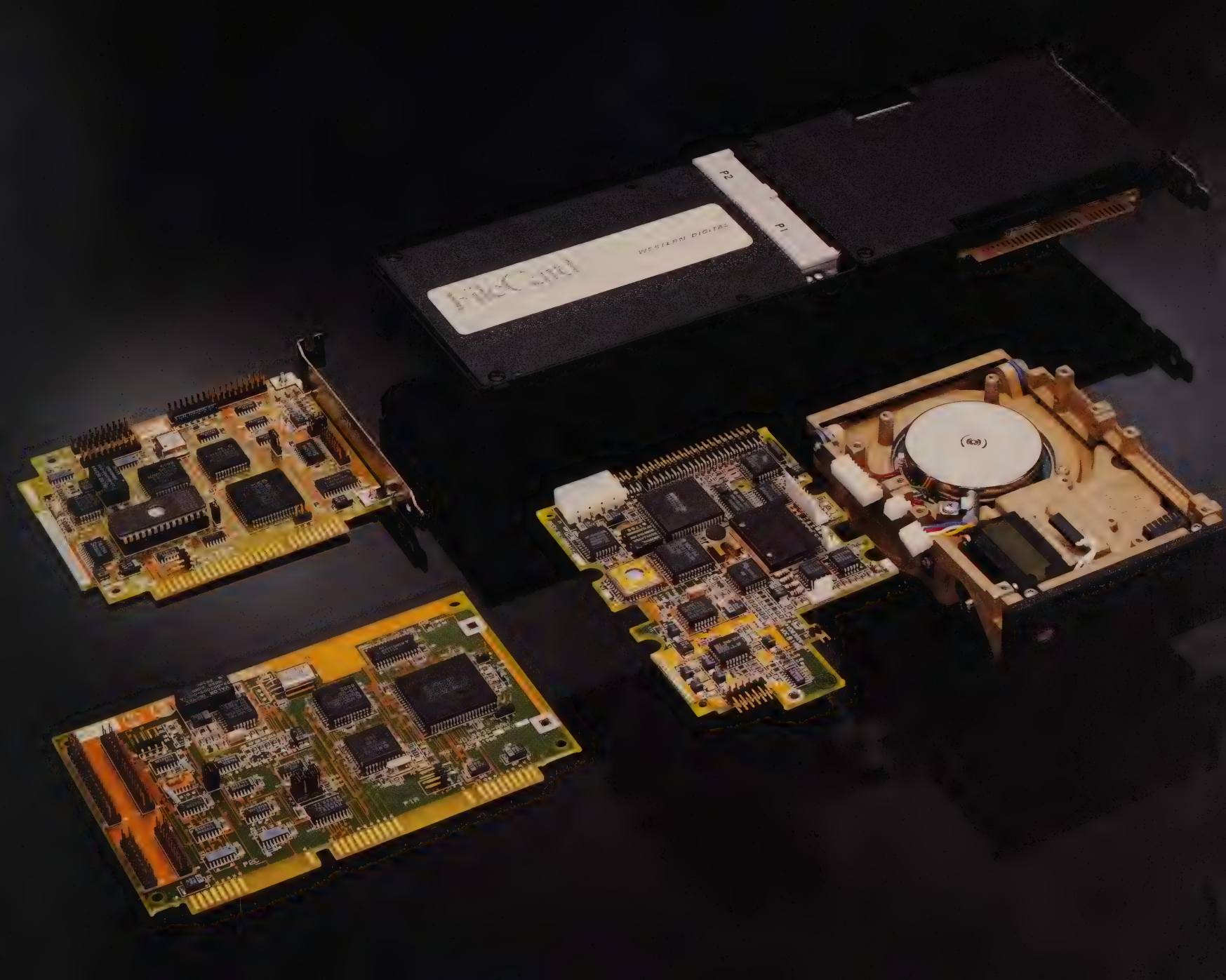
	Part Number	Technical Information	Power Requirements	Package Size	Product Description
Winchester Disk Support Devices	WD10C20B	CMOS, 5 MHz	+5V, +12V	28 pin DIP/QSM	Self-adjusting data separator and write precompensation device for MFM data. Includes internal delay line. Compatible with the WD1010, WD2010 and WD5010 devices.
	WD10C21A	CMOS, 10 MHz	+5V, +12V	28 pin DIP/QSM	Self-adjusting data separator and write precompensation device for RLL 2,7 data. Compatible with WD5011.
	WD11C00-13	CMOS, 5 MHz	+5V	20 pin DIP/ 28 pin QSM	32 bit ECC support device.
	WD11C00-14	CMOS, 10 MHz	+5V	20 pin DIP/ 28 pin QSM	56 bit ECC support device.
	WD11C00-17	CMOS	+5V	68 pin QSM	PC XT interface logic and ECC.
	WD11C00B-20	CMOS	+5V	68 pin QSM	SCSI bus interface device.
	WD11C00C-22	CMOS	+5V	84 pin QSM	PC AT interface logic and buffer manager.
	WD50C20A	CMOS, 10 MHz	+5V	40 pin DIP 44 pin QSM	ESDI Adapter device compatible with the WD5010A.
	ADS-3570	CMOS, 15 MHz	+5V	68 pin QSM	4 port buffer manager with priority resolution and a programmable SCSI port.
	ADS-5050	Transceiver	+5V	24 pin 0.3" DIP	Direct Interface to single-ended SCSI bus. For use with ADS 3570. Configurable for data or control bus.
SCSI Bus Controller Devices	WD33C92	CMOS	+5V	48 pin DIP/ 44 pin QSM	Single chip SCSI bus controller device with control signals for external drivers.
	WD33C93	CMOS	+5V	40 pin DIP/ 44 pin QSM	Single chip SCSI bus controller with internal 48 MA drivers.
	WD33C92A	CMOS	+5V	48 pin DIP/ 44 pin QSM	Feature enhanced 33C92.
	WD33C93A	CMOS	+5V	40 pin DIP/ 44 pin QSM	Feature enhanced 33C93.
SCSI Bus Host Adaptors	WD7000-ASC	Board	+5V	PC/AT	4MB/Sec intelligent 5651 channel controller for PC AT.
	WDSCS-XTS	Board	+5V	PC/XT	SCSI host adaptor for PC XT.
Winchester Board Products	WD1002S-WX2A	Board	+5V, +12V	3.85" x 8"	Winchester controller board with IBM PC XT compatible interface.
	WD1002A-WX1	Board	+5V, +12V	3.85" x 4.95"	Half-slot PC XT compatible Winchester controller board.
	WD1002-WXE	Board	+5V, +12V	3.85" x 5.5"	Half-slot PC XT compatible Winchester controller with radial connection + 2 disk drives.
	WD1002-27X	Board	+5V, +12V	3.85" x 4.95"	RLL 2,7 Half-slot PC XT compatible Winchester controller.
	WD1003-WAH	Board	+5V, +12V	3.85" x 10"	Winchester controller with IBM PC AT compatible interface. RLL 2,7 version available (-RAH).
	WD1003S-WAH	Board	+5V, +12V	3.85" x 6.5"	Surface mount technology version of WD1003-WAH. RLL 2,7 version available (-RAH).
	WD1003-WA2	Board	+5V, +12V	4.5" x 13.1"	Winchester and floppy controller board with IBM PC AT compatible interface. RLL 2,7 version (-RA2).
	WD1003A-WA2	Board	+5V, +12V	3.85" x 13.1"	XT form factor version of WD1003-WA2. RLL 2,7 version available (-RA2). Removable media version available.
	WD1005-WAH	Board	+5V	3.85" x 13.1"	ESDI controller board with IBM PC AT compatible interface.
	WD1006-WAH	Board	+5V, +12V	3.85" x 13.1"	High performance Winchester controller board with IBM PC AT compatible interface. Higher speed bus and 1 to 1 interleave support. RLL version available (-RAH).

PHOTO: Surface mount technology condenses more function into in less space and yields better reliability. Clockwise: FileCard 30, WD93020-XE1, WD1003S-RAH, and WD1002-27X.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P1
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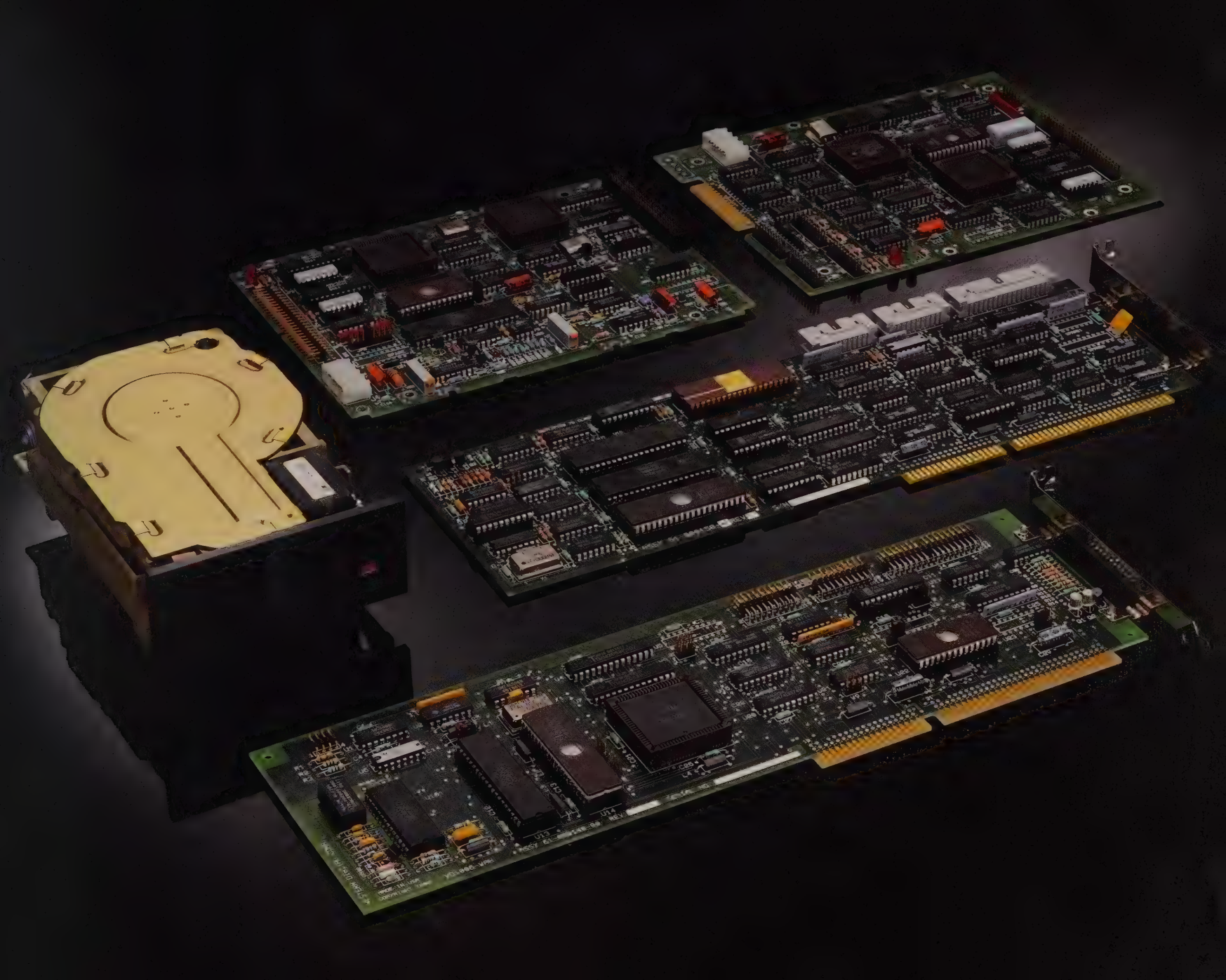
	Part Number	Technical Information	Power Requirements	Package Size	Product Description
Winchester Board Products	WD1002S-SHD	Board	+5V, +12V	5.75" x 4"	Winchester controller board with SASI interface; utilizes surface mount technology.
	WD1003A-SCS	Board	+5V, +12V	5.75" x 8"	SCSI interface Winchester controller board supports two ST506 disk drives. (RLL available.)
	ADS-D200/415S	Board Family	+5V	5.75" x 7.75"	SCSI interface Winchester controller board supports up to four ESDI disk drives. Synchronous data transfers.
Tape Drive Controller Products	ADS4360	CMOS	+5V	68 pin	Streaming tape interface controller for QIC-36 interface and QIC-24 and QIC-11 media formats.
	WD24C02	Single chip	+5V	40 pins	Read/write formatter.
	WD1036S-WX2	Board	+5V, +12V	3.85" x 13"	1/4" Tape Controller. (IBM PC XT to QIC-36).
	ADS-T100/ T100A	Board	+5V, +12V	5.60" x 7.75"	SCSI to QIC-36, QIC-120 tape controller board.
Integrated Winchester Disk Drives Includes Embedded Disk Controller on a Single Card	WD93020-XE1	Drive	+5V, +12V	1.6" x 3.9" x 5.1"	A half-height 3.5 inch, 20 Mbyte Winchester disk drive with an average access time of 85 ms and an IBM PC XT interface.
	WD93020-SE1	Drive	+5V, +12V	1.6" x 3.9" x 5.1"	A half-height 3.5 inch 20 Mbyte Winchester disk drive with an average access time of 85 ms and a SCSI interface.
Main Memory Device	WD8206	Single chip	+5V	68 pins	Error detection and correction device for main memory units (static and dynamic).
Optical Storage Support Devices	WD60C80	CMOS	+5V	28 pin DIP 28 pin QSM	Reed-Solomon ECC device with variable interleave.

COMMUNICATION PRODUCTS

Packet Switching	WD2511A	X.25 LAPB (1200 bps to 1.1 Mbps)	+5V, +12V	48 pin DIP	Complete link layer packet switching controller, CCITT X.25 compatible. On-chip dual channel DMA controller. Self-test features. Telenet® certified.
	WD2511G	Group IV FAX/ X.25 LABP controller (1200 bps to 1.1 Mbps)	+5V, +12V	48 pin DIP 68 pin Quad	Provides link layer protocol for Group IV facsimile machines to connect to packet switching networks plus all features of WD2511A.
	WD2507	CCITT Signalling System #7	+5V, +12V	48 pin DIP 68 pin Quad	Provides link layer of SS #7(Q.703). On chip dual channel DMA controller. Pin compatible with WD2511A.
	WD4025A-PCD	Plug-in Board for IBM PC, IBM XT, IBM AT and compatibles	+5V, −5V, +12V	3.85" x 13"	A high performance data link controller using the WD2511A chip with an RS-232-C interface. Supports HDLC and X.25 LAPB Communications. Includes MS-DOS™ driver software, data transfer utility programs and diagnostics.
	WD4025A-PCX25D	Plug-in Board with FleX.25 Software	+5V, −5V, +12V	3.85" x 13"	WD4025A-PCD product plus FleX.25 Software library that provides full X.25 services for software developers.
HDLC/SLDC Bit-Oriented Controller	WD1935/ 1935A	1.5, 2.0, MHz 3.0, 4.0	+5V	40 pin DIP	Synchronous Data Link Controller. Compatible with SDLC, ADCCP, HDLC and ISDN protocols. Received end-of-message status output. Supports SDLC loop mode. The WD1935 is available only in the 1.5 and 2.0 MHz speed version. The WD1935A is an enhanced version of the WD1935 and is more suitable for DMA interface.

PHOTO: Western Digital products address a wide variety of controller applications. Clockwise: SCSI to QIC-36 tape; SCSI to ESDI disk; PC AT to ESDI disk; PC AT to ST506 disk and an integrated disk drive for XTs and compatibles.



	Part Number	Technical Information	Power Requirements	Package Size	Product Description
Local Area Networks	WD8000SL	StarLAN PC Adapter Board	+5V	2.4'' x 5.4''	StarLAN station adapter board for IBM PC, XT, AT and compatible with system clocks up to 16 MHz.
	WD8000SH	StarLAN PC Adapter Board with Integral Hub	+5V, +12V	3.9'' x 5.2''	WD8000SL board with StarLAN compatible 1-port hub for daisy chaining.
	WD8000SH2	StarLAN PC Adapter Board with Integral Hub	+5V, +12V	3.9'' x 5.2''	WD8000SL board with StarLAN compatible 2-port hub for daisy chaining.
	WD8003S	High Performance StarLAN PC Adapter Board	+5V	3.9'' x 6.0''	StarLAN adapter board with high performance LAN controller and 8K buffer memory.
	WD8003E	Ethernet/Thin Ethernet PC Adapter Board	+5V, +12V	3.9'' x 5.25''	Ethernet adapter board with high performance LAN controller, 8K buffer memory and on-board Thin Ethernet transceiver.
	WD8010	10-Port StarLAN Hub	115VAC, 60Hz 230VAC, 50Hz 20 Watts Max.	D 6.6'' x H 2.0'' x W 13.8''	Standalone 10-port StarLAN hub with built-in system test capability.
	WD83C503	StarLAN Mini-Hub Controller	+5V	28 DIP 44 PLCC	3-Port StarLAN hub controller for use on StarLAN adapter boards.
	WD83C510	StarLAN Hub Controller	+5V	40 DIP 44 PLCC	10-Port StarLAN hub controller cascadable to support up to 40 ports.
	WD83C580	PC Bus Interface Controller	+5V	68 PLCC	Handles interface between IBM PC bus and PC adapter boards.
	WD2840A	Token Access Controller (1.0 Mbps)	+5V, +12V	48 pin DIP	Local Area Network controller for token passing. Transmission media, topology and operating system independent. Automatic network reconfiguration. Built-in DMA.
Data Security	WD2001/ WD2002	0.5, 2.0 and 3.0 MHz Clock	+5V, +12V	28 pins	Single and dual port Data Encryption device. Executes DES algorithm (FIPS 46).
	WD20C03	4.0, 5.0 and 6.0 MHz clock	+5V	28 pins	Single port CMOS Data Encryption device which incorporates the DES algorithm. Encrypts using either Electronic Code Book (ECB) or Cipher Block Chaining (CBC). Functional and pin compatible to the WD2001.
UART Universal Asynchronous Receiver/ Transmitter	TR1863/ TR1865	1.0, 2.5 and 3.5 MHz Clock	+5V	40 pins	UART. Programmable Transmitter/Receiver. Selectable Word Length, Stop Bits (1, 1.5 or 2 stop bits), and Parity (even, odd, or none). Features false start bit detection, three-state status data outputs. The TR1865 has internal pull-up resistors on all inputs.
BOART Bus-Oriented Asynchronous Receiver/ Transmitter	WD8250/ WD82C50/ WD16C450	3.1 MHz Clock	+5V	40 pins	ACE. Asynchronous Communication Element. Bus oriented UART with on-chip Baud Rate Generator, prioritized interrupt controls, RS-232 interface and double buffering. The WD82C50 is the CMOS version of the WD8250. The WD16C450 is an enhanced version of the WD82C50.
	WD2123	1.8 MHz Clock	+5V	40 pins	DEUCE, 2-channel BOART. Bus oriented UART. On-chip dual Baud Rate Generator. Software compatible with WD8251A.

PHOTO: Communication products encompass both LANs and WANs. Clockwise: StarHub, ViaNet software, and the low cost StarCard with its StarLAN connection

StarHub
10
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1

	Part Number	Technical Information	Power Requirements	Package Size	Product Description
ASTRO Asynchronous/ Synchronous/ Transmitter/ Receiver	UC1671	1.0 MHz	+5V, −5V	40 pins	ASTRO, Designed for multiplexed bus operation with other bus-oriented devices. Vectored interrupt capability and pin programmable ID address (maximum 32 ASTROs). Double buffering, 8 selectable clock rates, on line diagnostic.
GPIB Controller	WD9914	0.5 to 5.0 MHz clock	+5V	40 pins	Provides interface between a microprocessor and the IEEE 488 GPIB. Talker, Listener, and Controller functions.
LIFO/FIFO Buffers	WD1510	0.65, 1.0, and 1.5 MHz	+5V	28 pins	Selectable word length. 9 bit by 182 or 132 wide. Two bi-directional Async data ports. Can function as FIFO or/and LIFO.
Baud Rate Generators	WD1943/ WD1945	Xtal or TTL	+5V	18 pins	Dual Baud Rate Generator. 3 versions of Selectable Baud Rate. The WD1945 has an F/4 output.
CRT Controller	WD8275	2.0 and 3.0 MHz	+5V	40 pins	Programmable CRT Controller to interface a raster scan display with computer systems. Programmable screen and character formats, also has cursor control. 11 visual characters and 6 field attributes: light pen detection and registers.
	WD8276	2.0 and 3.0 MHz	+5V	40 pins	Programmable CRT Controller to interface with a raster scan display with micro computer systems. Programmable screen and character formats, also has cursor controls. 6 field attributes.

RETAIL PRODUCTS

FileCard20™	WD20ifc	3.5" 20 Mbyte DOS 2.0 or higher	+5V, +12V 12 Watts Typical	L 13" x H 4.1" x W 1.6"	Complete 20 Mbyte hard disk slot card for IBM PC XT, compatibles and compatible portables. Uses 1 or 1.5 slots. Includes user installation guide, operates as drive C or D.
FileCard30™	WD30ifc	3.5" 30 Mbyte DOS 2.0 or higher	+5V, +12V 12 Watts Typical	L 13" x H 4.1" x W 1.6"	Same as above but 30 Mbyte RLL design.
PortaFile™	WD20xSAS	3.5" 20 Mbyte Capacity DOS 2.0 or Higher	Host Adapter requires 5 Watts Max. from PC motherboard	L 10.25" x H 5.5" x W 6.25	Complete 20 Mbyte Winchester portable expansion system for IBM PC XT, certain compatibles and compatible portables. System Includes: 20 Mbyte Winchester drive, Western Digital Controller Board, XSASI host adapter, custom power supply in a self-contained, portable case with carry handle, interface and power cables, and user installation guide.
WD60Ti	WD60Ti	60 Mbyte Capacity Q1C36 Interface Q1C24 Format	+5V + 5% at 2 Amps Max. +12V + 5% at 4 Amps Max 25 Watts Typical	Occupies 5.25" Half-Height Spaces	Complete 60 Mbyte 1/4" internal backup System for IBM PC, XT, AT, and certain compatibles. System includes: 60 Mbyte 5.25" half-height drive, Western Digital tape controller board, menu-driven backup software with manual. Supports DOS 2.0 or higher.
WD20i/30i	WD20i/30i	3.5" 20 or 30 Mbyte Capacity DOS 2.0 or Higher PC XT, PC AT and Compatibles	+5V, +12V 12 Watts Typical	Occupies 3.5"/5.25" Full-Height or Half-Height Spaces	Complete storage expansion system for PC, XT, AT, compatibles, and compatible portables, System includes: Western Digital controller board, 20 or 30 Mbyte 3.5" Winchester Drive in a 5.25" shock-mounted frame, half and full-height front bezels, cables, mounting hardware, and User Installation Guide.

	Part Number	Technical Information	Power Requirements	Package Size	Product Description
DialCard25	DialCard25™	Plug-in card for IBM PC AT, IBM PC XT and compatibles	+5V, +12V, −12V	Occupies one internal slot in an IBM PC	A low-cost interface card that provides a gateway for IBM PC users to access a packet data network through a leased line or dial-up modem. The Dialcard25 includes user friendly software from Telenet and WD4025A X.25 interface card.
StarLAN	StarCard™	StarLAN PC Adapter Board	+5V	2.4'' x 5.4''	An end user version of the WD8000SL. It allows a PC to function as a station in a StarLAN network.
	StarLink™	StarLAN PC Adapter Board with Integral Mini Hub	+5V, +12V	4.0'' x 5.25''	An end user version of the WD8000SH. Allows a PC to function as a station and a single port hub in a StarLAN network. This card is required for daisy chaining.
	StarHub	10-Port StarLAN Hub	115VAC, 60Hz 230VAC, 50Hz 20 Watts Max.	D 6.6'' x H 2.0'' x W 13.8''	An end user version of the WD8010. StarHub is the hub, or central point, in a star type configuration. StarHub supports up to 10 connections.
	ViaNet™	Networking Software	N/A	2 floppy diskettes and full documentation	Western Digital's ViaNet® offers the user a powerful, easy-to-install LAN operating system which makes networking simple.
	WDNet/86™	Networking Software	N/A	14 floppy diskettes and full documentation	Western Digital's OEM version of Advanced NetWare® by Novell, Inc. Supporting 8 or 100 users, this network file server software provides ease-of-use, flexibility, compatibility and performance.
	WDNet/286™	Networking Software	N/A	14 floppy diskettes and full documentation	Western Digital's OEM version of Advanced Netware® /286 by Novell, Inc. Supporting 100 users, this network file server software provides ease-of-use, flexibility, compatibility and performance.

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NOTE: Unless otherwise noted, all power requirement voltages given are direct current. Specifications are subject to change without notice

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WD1002-27X Winchester Disk Controller PRELIMINARY USER'S GUIDE

WESTERN DIGITAL

CORPORATION

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Ken Wing WX6P

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If interference problems do occur, please consult the system equipment owner's manual for suggestions. Some of these suggestions include relocation of the computer system away from the television or radio or placing the computer AC power connection on another circuit or outlet.

Western Digital recommends use of shielded external interconnecting cables.

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DESCRIPTION

The WD1002-27X is a stand-alone, general purpose Winchester Disk Controller. The WD1002-27X interfaces up to two Winchester disk drives and a Host processor, e.g. an IBM Personal Computer XT. The Winchester interface conforms to the Seagate Technology ST412 interface with a Run Length Limited (RLL) serial data interface.

There are five versions of the WD1002-27X. Feature 000 (F000) contains n Basic Input/Output System (BIOS) ROM or mounting bracket. F007 contains no BIOS ROM but a mounting bracket is attached to the controller. F019 contains a standard BIOS (BIOS 0). Translation on F019 board occurs in the WD1015-08. F022 contains a 26 sector to 17 sector translation BIOS (BIOS 1). F016 contains a 26 sector BIOS (BIOS 2). Western Digital supplies a mounting bracket with Features 019, 022, and 016.

Part numbers for the three BIOS Features are as follows:

62-000087-030	F019
62-000088-030	F022
62-000089-030	F016

INSTALLATION INSTRUCTIONS

This section contains instructions for installation of the WD1002-27X (27X) board. If the disk drive(s) are being installed internally, it is best to locate the 27X controller board in the closest available expansio slot to the internal drive. However, expansion slot J8 in the IBM Personal Computer XT should not be used because of its modified select an timing characteristics.

CAUTION

Handle the controller board by the ends of the board. Some of the chips are static sensitive and damage may occur if the board is incorrectly handled.

At this time, verify that the jumper settings on the controller board are correct. Only verify the settings. Modification of the factory jumper settings is rarely necessary. Modify jumpers only under the direction of a qualified individual, i.e. your dealer. Refer to the Tables 1 and 2 fo further information on the jumper settings. Table 1 describes jumpers W3 through W9. Table 2 describes the settings for S1. Figure 1 illustrates the jumper locations on the 27X.

Jumper	Pin Connects	Description
W1 & W2		Not applicable to 27X. Eliminated by artwork changes to board.
W3	CLOSED	BIOS ROM enabled. Board shipped with jumper in this position.
	OPEN	BIOS disabled.
W4	1-2	Secondary addresses 324 through 327 hex. User must acquire custom DOS drivers to utilize this feature.
	2-3	Primary addresses 320 through 323 hex. Board shipped with jumper in this position.
W5	1-2	2732 or 2764 BIOS ROM. Board shipped from factory with pins 1-2 connected with an etch. To change, etch must be carefully cut and a jumper installed.
	2-3	2716 BIOS ROM. Not used in most configurations.
W6	1-2	16 head disk drive configuration.
	2-3	8 head disk drive with REDUCED WRITE CURRENT (RWC) configuration. Board shipped from factory with jumper in this position.
W7	1-2	INTERRUPT REQUEST 5 (IRQ5). Board shipped from factory with pins 1-2 connected with an etch. To change, etch must be carefully cut and a jumper installed.
	2-3	IRQ2. Not used in most configurations. Requires custom BIOS and and closing S1.
W8	1-2	Special setting for certain Original Equipment Manufacturers (OEMs).
	2-3	Standard factory setting.
W9	CLOSED	Enables firmware (WD1015) translation. Standard factory setting for F000, F007, and F019.
	OPEN	Disables firmware translation. Standard factory setting for F016 and F022.

BIOS TABLE	DRIVE 1 S1	S2	DRIVE 0 S3	S4	FORMATTED CAPACITY	HEADS	CYLINDERS *PHYSICAL* LOGICAL	DRIVE TYPE
0	CLOSED	CLOSED	CLOSED	CLOSED	65 MB	5	*981* 1023	Tandon TM Vertex V1
1	OPEN	CLOSED	OPEN	CLOSED	92 MB	7	*987* 1023	Priam V17
2	CLOSED	OPEN	CLOSED	OPEN	33 MB	4	*612* 935	Microscier HH-725 or Miniscrib 3425
3	OPEN	OPEN	OPEN	OPEN	33 MB	4	*615* 940	Seagate ST238

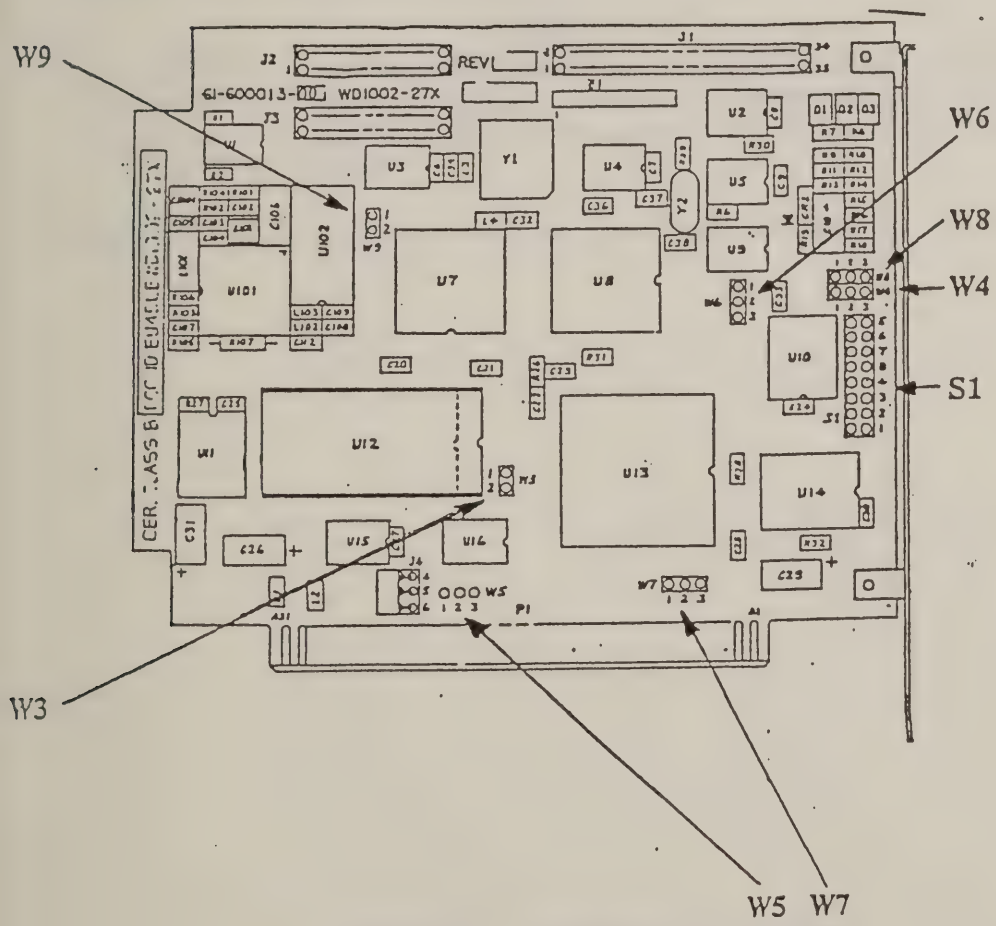

FIGURE 1. JUMPER LOCATIONS

complete set of instructions for

Next, remove the blank expansion slot bracket. Put the bracket away and save it for possible future use. The screw will be used to hold the new controller board in place.

Connect the 34-pin (wide control cable) connector to J1 on the 27X board. Make sure that pin 1 of the cable connector goes to pin 1 on the controller board. Pin 1 of the cable connector is typically located on the color coded side of the cable.

Connect the 20-pin (data cable) to J2 (drive 0 data connector) on the controller board. Make sure that pin on the cable is connected to pin 1 on the controller board.

If a second drive is being installed, connect the drive 1 data cable to J3 likewise.

At this time, also verify that the disk drive(s) is properly installed. This includes correct placement of drive select jumpers and drive terminator installation. Refer to the disk drive installation manual for further instructions. DO NOT USE THE DRIVE'S RADIAL SELECT OPTION.

Install the controller board into the expansion slot. Make sure that the board is seated properly by pressing down on both ends of the board. Secure the board with the bracket screw.

CAUTION

When routing the cables, be careful not to pinch them. Cables must not get caught between the cover and the boards nor should they obstruct any air flow path from fans or vents.

Install the disk drive(s) per manufacturer's instructions.

The following procedures are a complete set of instructions for formatting one or two disk drives when using a WD1002-27X controller board with either a F019, F022, or F016 BIOS ROM.

The DEBUG Utility is used to initiate the RLL format program to physically format the drive. During execution, the user is prompted to define the interleave factor. Please refer to the DOS operating manual for detailed instructions regarding this utility.

Step Instructions

1. At the A> prompt, load and run the DOS DEBUG Utility by typing DEBUG followed by a RETURN. "CR" stands for carriage return or ENTER.

   A> DEBUG CR

   The next step changes the drive address and sector interleave factor. If not modified, the drive number will default to 00 and the interleave factor will default to four. Proceed with step 2 if there are two hard disk drives configured into the system and/or the desired interleave factor is to be other than four. If neither applies, go directly to step 3.

2. At the debug prompt, type the following line to set the target drive number and interleave factor. The debug prompt is the hyphen "-".

   - rax CR

   CPU response:

   AX 000
   :__

   At the colon prompt, enter drive number and interleave factor in bexidecimal followed by a RETURN.

   xxyy CR

   Where: xx = the relative drive number
   yy = the interleave factor
   Relative drive C: = 00, relative drive D: = 01. An interleave factor of 04 is standard. If formatting two drives, this operation must be run twice; first with the relative drive number = 00 and again with it = 01.

3. At the debug prompt, initiate the RLL format program by typing in the following command line:

   -g=c800:5 CR

The RLL format program displays the following:

```
RLL Format Revision 7.0 (C) Copyright Western Digital Corp. 1986

(AH) = Relative drive number (0-7)
(AL) = Interleave factor (4 is standard)
Press "Y" to begin formatting drive XX with interleave YY
```

CAUTION

Before responding, please remember that all data on the target drive will be lost during execution of the format program. Hit any other key to abort the format program and save the data.

4. Press "Y" followed by a RETURN to begin formatting the drive.

Y CR

System responses:
If any key other than "Y" is typed, the program displays the following message and returns the operator to DOS.

CPU response:

```
Nothing done exit
A>
```

If "Y" is typed, formatting is initiated. The format program can take up to five minutes. If there are no resulting errors, the program displays the following message and returns the operator to DOS.

CPU response:

```
Format Successful
A>
```

If an error occurs while formatting, the program will immediately terminate, display the following error message, and return the operator to DOS. XX is the hexidecimal 27X BIOS completion code. Refer Table 3 on page 7.

CPU responses:

```
Error ---- completion code XX
A>
```

If a second drive is to be formatted, repeat steps 1 through 5 with the relative drive number equal to 01. Otherwise, continu with step 5.

5. Load and execute the FDISK and FORMAT utilities. Refer to your DOS manual for more information on FDISK and FORMAT.

TABLE 3. 27X ERROR CODES

CODES	COMPLETION CODE SUMMARY
01	Bad Command
02	Address Mark Not Found
04	Sector Not Found
05	Reset Failed
07	Set Parameters Failed
09	Attempt to DMA across 64 K boundary
0B	Bad Track
10	Bad Track
11	ECC Error Corrected
20	Controller Failure
40	Seek Failure
80	Time-out
BB	Undefined Error
FF	Read Status Failed